Chapter 4

Existing Environmental Resources and Demographics

CHAPTER 4

EXISTING ENVIRONMENTAL RESOURCES AND DEMOGRAPHICS

4.1 INTRODUCTION

This chapter provides a summary of the Town of Chatham's existing conditions, environmental resources, land use, zoning, and demographics. The Town's environmental resources are defined by the Town's topography, geology and soils, groundwater, surface waters, coastal embayments, wetlands, flood plains, forests, and protected natural areas. Each of these existing conditions has been identified through review of existing Town documents and records, interviews, and site evaluations made by the project team.

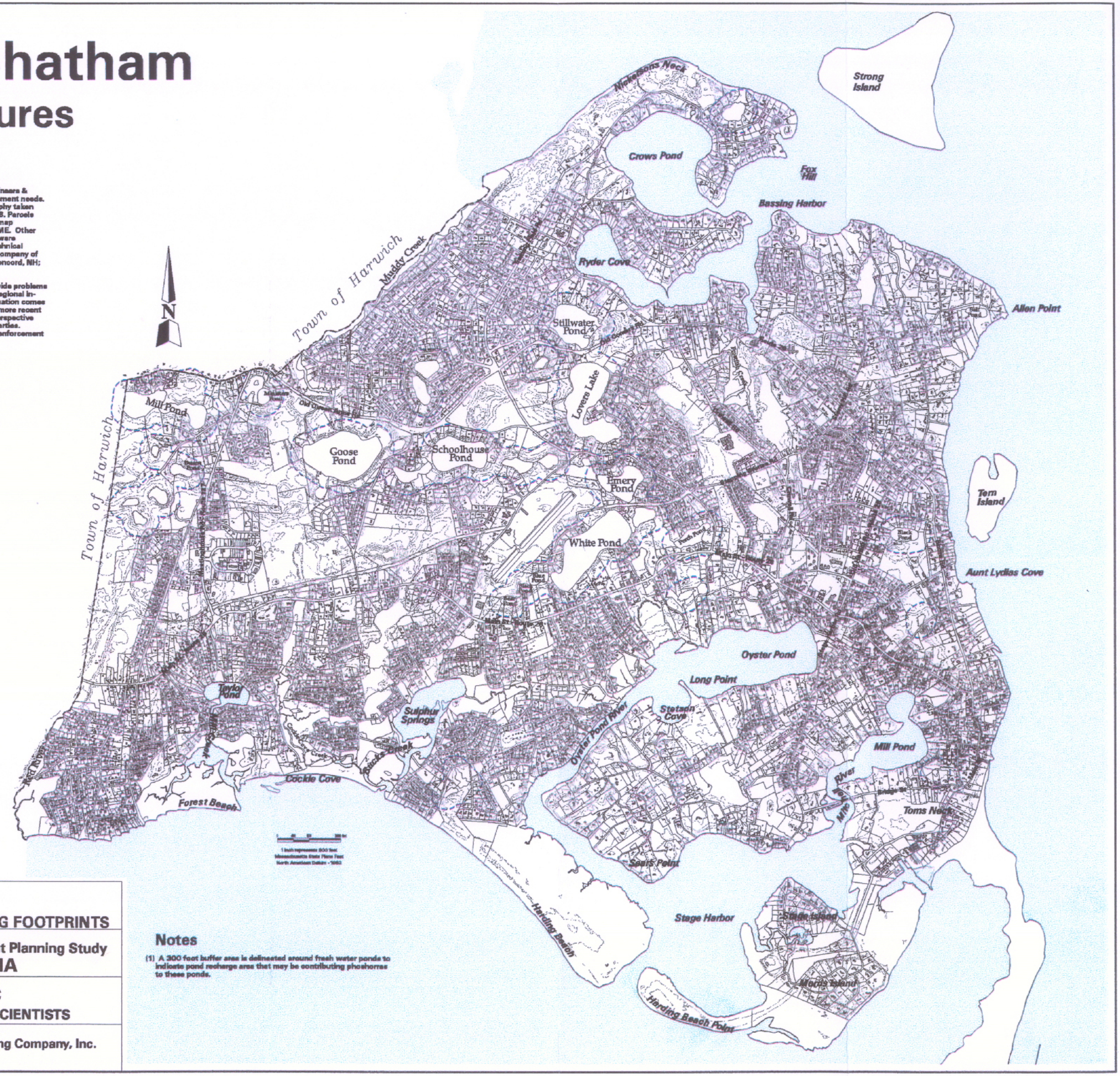
4.2 NATURAL RESOURCES

A. Topography. Chatham, like most towns in Cape Cod, is comprised mostly of glacial deposits. Chatham consists of hilly wooded areas to the north and west and barrier beaches to the south and east. Chatham has numerous kettle hole ponds, salt-water pond estuaries, beaches and coastal dunes. Ground elevations in Town vary from Mean Sea Level (MSL) to an elevation of 130 feet at Great Hill. The Town is bordered to the north by Pleasant Bay, to the south by Nantucket Sound, to the east by the Atlantic Ocean, and the West by the Town of Harwich. The mainland part of town is approximately 7,600 acres. This does not include the 2,900 acres, which make up Strong Island, Monomoy Island, and Nauset Beach (which is part of the Cape Cod National Seashore). Chatham's surface topography is identified on Figure 4-1.

Town of Chatham
Physical Features

This map is being made for Stearns & Wheler LLC, Environmental Engineers & Scientists for the purpose of studying Chatham's wastewater management needs. Surface contours and building footprints are based on aerial photography taken in 1990 and convert to GIS format by Applied Geographics Inc. in 1998. Parcels were digitized in 1998 from the 1998 assessors maps. Original mylar map linework was delineated by the James Sewall Company of Old Town, ME. Other base map features such as coastlines, water bodies, and road names were automated by the Cape Cod Commission GIS department. Special technical assistance was provided by MassGIS of Boston, MA; the Mapworks Company of Norwell, MA; Earth Tech LTD.; the East Coast Mapping Company of Concord, NH; and the Town of Chatham.

This map has been developed as a planning tool to investigate town-wide problems related to wastewater treatment and disposal. Much town-wide and regional information has been integrated to produce this map. The source information comes from a variety of dates, as noted above, and therefore may not reveal more recent changes. Also, the source information was digitized with a regional perspective and this may show inherent inaccuracies pertaining to individual properties. This map does not intend to provide design information or regulatory enforcement for individual properties.



Legend

- Building Footprints
- Property Lines
- Coastline (Fresh & Saltwater)
- Town Boundary
- 10 Foot Contours
- 300 Foot Buffer Perimeter around Fresh Surface Water Bodies (1)

FIGURE 4-1
SURFACE CONTOURS AND BUILDING FOOTPRINTS

Comprehensive Wastewater Management Planning Study
Town of Chatham, MA

Stearns & Wheler, LLC
ENVIRONMENTAL ENGINEERS & SCIENTISTS

Map prepared by Harvard Design and Mapping Company, Inc.

Notes

(1) A 300 foot buffer area is delineated around fresh water ponds to indicate pond recharge area that may be contributing phosphorus to these ponds.

B. Geology/Soils. The Chatham Open Space and Recreation Plan describes the Town of Chatham as being divided into two geologic units: Chatham Kame deposits, and Harwich outwash plains. Bedrock is estimated to be 250 to 500 feet below MSL, and the glacial deposits are presumed to be underlain by layers of clayey silt and compacted till. The Chatham Kame deposit is a 1.5-mile long steep ridge in the middle of Chatham, due south of Ryders Cove. This formation is surrounded by the Harwich outwash plains, with larger boulders and till located to the east of the Kame deposit (Open Space and Recreation Plan, 1985).

According to the Barnstable County Soil Survey, (USDA, Soil Conservation Service, 1993) Chatham contains 25 specific soil types and 5 general types. The predominant type is the Carver Coarse Sands. These sands are very deep, excessively well drained soils, with slopes from 0 to 35 percent. Various sandy loams, loamy sands, and mucks make up the remainder of specific soil types in Chatham. Figure 4-2 depicts the soils of Chatham as developed by the USDA- Soil Conservation Service.

Metcalf & Eddy's (M&E) 1982 Facilities Plan identified several areas of soil type in Chatham that were undesirable or unsuitable for on-site wastewater treatment systems. Undesirable soils were characterized by M&E as having: steep slopes, outcrops, susceptible to flooding, high shrink-swell potential, seasonal high groundwater, and poor permeability. Unsuitable soils were characterized as being of low permeability. According to their findings, areas south of Route 28 and along the eastern shore of the Town, were those most often impacted by high groundwater and poor permeability. Other areas in Town with similar soil limitations surround the numerous ponds and estuaries north and west of Route 28.

Discussions with the Town of Chatham's Health Agent generally agreed with these areas of poor soil conditions. The only major discrepancy was an area east of Bucks Creek to Hardings Beach Road. According to the Town, this area is not impacted by high groundwater as shown on the M&E map. It was also pointed out that an area near Old Main Street has low permeability soils. Also, the

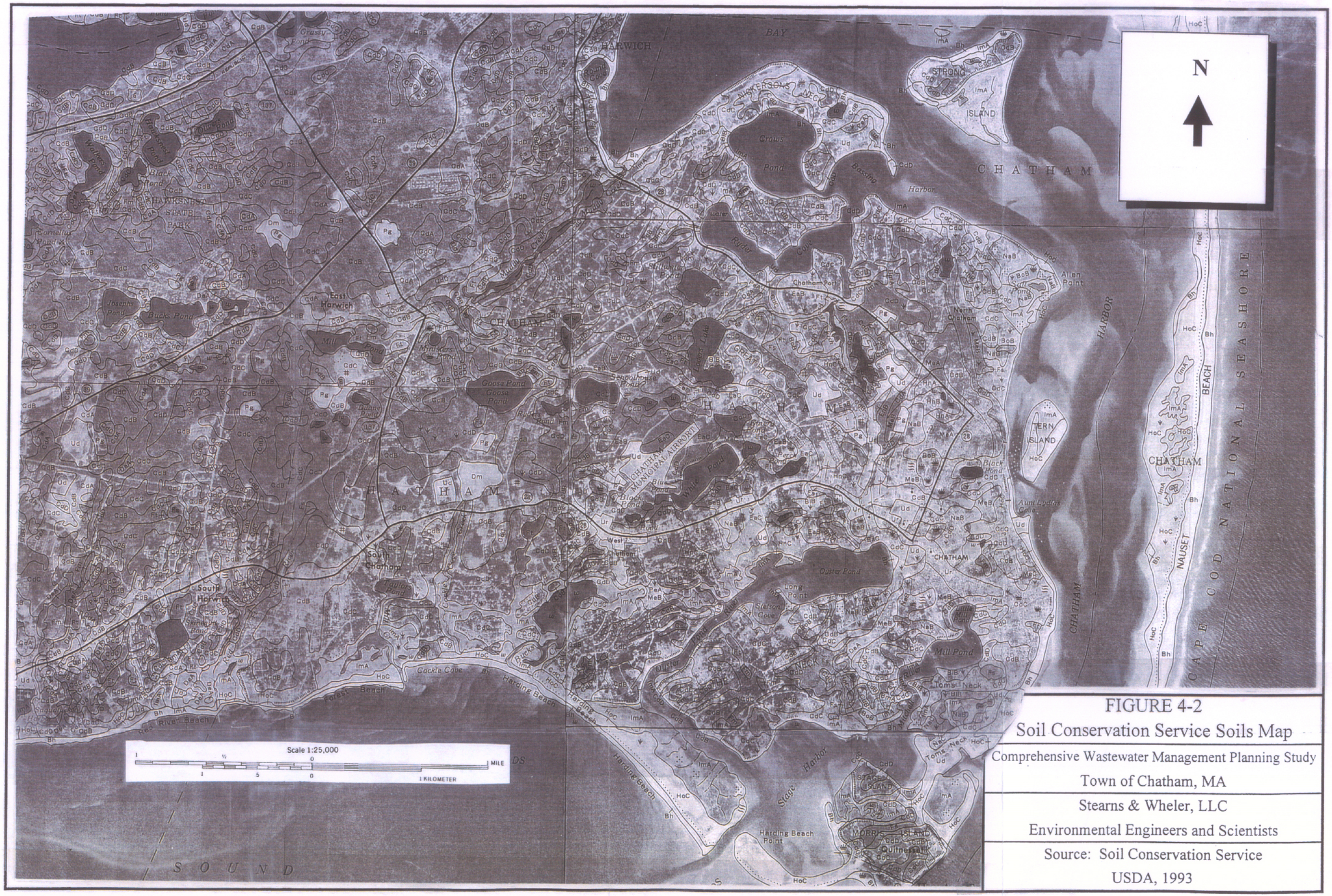


FIGURE 4-2

Soil Conservation Service Soils Map

Comprehensive Wastewater Management Planning Study

Town of Chatham, MA

Stearns & Wheler, LLC

Environmental Engineers and Scientists

Source: Soil Conservation Service

USDA, 1993

SOIL LEGEND

Publication symbols consist of letters (e.g. AmA, BeC, MeD). The first letter, always a capital, is the initial letter of the soil name. The second letter is lower case and separates map units except that it does not separate slope phases. The third letter, always a capital: A, B, C, or D indicates the slope. Symbols without a slope letter are for nearly level soils, however, some are for soils that have a considerable range of slope but have similar use and interpretations.

SYMBOL	NAME
AmA	Amostown sandy loam, 0 to 5 percent slopes
BaB	Barnstable sandy loam, 3 to 8 percent slopes
BaC	Barnstable sandy loam, 8 to 15 percent slopes
BbB	Barnstable sandy loam, 3 to 8 percent slopes, very stony
BbC	Barnstable sandy loam, 8 to 15 percent slopes, very stony
BbD	Barnstable sandy loam, 15 to 25 percent slopes, very stony
BcC	Barnstable-Plymouth complex, rolling
BdC	Barnstable-Plymouth complex, rolling, bouldery
BeC	Barnstable-Plymouth complex, rolling, very bouldery
BfC	Barnstable-Plymouth-Nantucket complex, rolling
BgC	Barnstable-Plymouth-Nantucket complex, rolling, very bouldery
Bh	Beaches
BlB	Belgrade silt loam, 3 to 8 percent slopes
BmA	Berryland mucky loamy coarse sand, 0 to 2 percent slopes
BoA	Boxford silt loam, 0 to 3 percent slopes
BoB	Boxford silt loam, 3 to 8 percent slopes
CcA	Carver loamy coarse sand, 0 to 3 percent slopes
CcB	Carver loamy coarse sand, 3 to 8 percent slopes
CdA	Carver coarse sand, 0 to 3 percent slopes
CdB	Carver coarse sand, 3 to 8 percent slopes
CdC	Carver coarse sand, 8 to 15 percent slopes
CdD	Carver coarse sand, 15 to 35 percent slopes
CoB	Carver-Hinesburg loamy coarse sands, undulating
CoC	Carver-Hinesburg loamy coarse sands, rolling
CoD	Carver-Hinesburg loamy coarse sands, hilly
DeA	Deerfield loamy fine sand, 0 to 5 percent slopes
Dm	Dumps, landfill
Dn	Dune land
EaA	Eastchop loamy fine sand, 0 to 3 percent slopes
EaB	Eastchop loamy fine sand, 3 to 8 percent slopes
EaC	Eastchop loamy fine sand, 8 to 15 percent slopes
EnA	Enfield silt loam, 0 to 3 percent slopes
EnB	Enfield silt loam, 3 to 8 percent slopes
EnC	Enfield silt loam, 8 to 15 percent slopes
Fm	Freetown mucky peat, 0 to 1 percent slopes, ponded
Fs	Freetown and Swansea mucks, 0 to 1 percent slopes
Ft	Freetown coarse sand, 0 to 1 percent slopes
HeA	Hinckley sandy loam, 0 to 3 percent slopes
HeB	Hinckley sandy loam, 3 to 8 percent slopes
HkC	Hinckley gravelly sandy loam, 8 to 15 percent slopes
HkD	Hinckley gravelly sandy loam, 15 to 35 percent slopes
HnA	Hinesburg sandy loam, 0 to 3 percent slopes
HnB	Hinesburg sandy loam, 3 to 8 percent slopes
HnC	Hinesburg sandy loam, 8 to 15 percent slopes
HoC	Hooksan sand, rolling
HoD	Hooksan sand, hilly
HxC	Hooksan-Dune land complex, hilly
ImA	Ipswich, Pawcatuck, and Matunuck peats, 0 to 1 percent slopes
MaA	Maybid silt loam, 0 to 3 percent slopes
MbA	Maybid Variant silty clay loam, 0 to 1 percent slopes
MeA	Merrimac sandy loam, 0 to 3 percent slopes
MeB	Merrimac sandy loam, 3 to 8 percent slopes
MeC	Merrimac sandy loam, 8 to 15 percent slopes
MeD	Merrimac sandy loam, 15 to 25 percent slopes
Mg	Merrimac-Udipsamments-Urban land complex
NaB	Nantucket sandy loam, 3 to 8 percent slopes
NaC	Nantucket sandy loam, 8 to 15 percent slopes
NsB	Nantucket sandy loam, 3 to 8 percent slopes, stony
NsC	Nantucket sandy loam, 8 to 15 percent slopes, stony
PeA	Pipestone loamy coarse sand, 0 to 3 percent slopes
Pg	Pits, sand and gravel
PmA	Plymouth loamy coarse sand, 0 to 3 percent slopes
PmB	Plymouth loamy coarse sand, 3 to 8 percent slopes
PmC	Plymouth loamy coarse sand, 8 to 15 percent slopes
PmD	Plymouth loamy coarse sand, 15 to 35 percent slopes
PsB	Plymouth loamy coarse sand, 3 to 8 percent slopes, very stony
PsC	Plymouth loamy coarse sand, 8 to 15 percent slopes, very stony
PsD	Plymouth loamy coarse sand, 15 to 35 percent slopes, very stony
PvC	Plymouth-Barnstable complex, rolling, very bouldery
PvD	Plymouth-Barnstable complex, hilly, very bouldery
PxC	Plymouth-Barnstable complex, rolling, extremely bouldery
PxD	Plymouth-Barnstable complex, hilly, extremely bouldery
PyD	Plymouth-Barnstable-Nantucket complex, hilly, very bouldery
ScA	Scitico silt loam, 0 to 3 percent slopes
SdA	Sudbury fine sandy loam, 0 to 3 percent slopes
Ud	Udipsammments, smoothed
Ur	Urban land
WvA	Walpole sandy loam, loamy subtratum, 0 to 3 percent slopes
W	Water

FIGURE 4-2 (Continued)

SOIL CONSERVATION SERVICE SOILS MAP

Comprehensive Wastewater Management Planning Study

Town of Chatham, MA

Stearns & Wheler, LLC

Environmental Engineers and Scientists

Source: Soil Conservation Service USDA, 1993

area at the end of Nickerson Neck originally identified by M&E as subject to low elevations and high groundwater was expanded to include a larger area of land. Figure 4-3 illustrates areas of Town with soils that are generally unsuitable for on-site wastewater treatment systems.

C. Groundwater.

1. Background and Previous Studies. As identified in Chapter 2, several studies and reports have been written on the Town of Chatham's groundwater system. Of these reports, those by Metcalf & Eddy, the Cape Cod Commission, and by Whitman & Howard, provide the most comprehensive Town wide information.

The Town of Chatham receives its drinking water from the Monomoy Lens, which is a sole source aquifer that also provides drinking water to Harwich, Dennis, Brewster, and Orleans. Water supply and usage for the Town of Chatham will be discussed further in Chapter 5 of this Report.

This section reviews aspects of the Monomoy Lens including its flow direction, elevation, and water quality. It also identifies public water supplies and existing Zone IIs, mounding at the WPCF and ongoing groundwater sampling programs.

2. Flow Direction and Elevation. Groundwater flow has been examined several times and referenced in several reports. These reports indicate that groundwater recharge occurs at the central parts of Chatham and flows towards Nantucket Sound, Chatham Harbor and Pleasant Bay. Several pumping tests have been conducted in Chatham to determine the Zones of Contribution (ZOC) for existing and future drinking water supply wells. Values of hydraulic conductivity from these tests have ranged from 38 to 290 ft/day, with a typical value estimated at 150 ft/day. Many reports identify the existence of an upper and lower aquifer system, separated by a segmented silty

Town of Chatham
High Groundwater Areas

This map is being made for Stearns & Wheler LLC, Environmental Engineers & Scientists for the purpose of studying Chatham's wastewater management needs. Parcels were digitized in 1998 from the 1998 assessors maps. Original mylar map linework was delineated by the James Sewall Company of Old Town, ME. Sewered parcels, sewer pipe lines, and the water pollution control facility were digitized in 1998 for the Cape Cod Commission's Regional Policy Plan. Other base map features such as coastlines, water bodies, and road names were automated by the Cape Cod Commission GIS department. Special technical assistance was provided by MassGIS of Boston, MA; the Mapworks Company of Norwell, MA; Earth Tech LTD.; the East Coast Mapping Company of Concord, NH; and the Town of Chatham. Areas with low permeability soils are from the Town's 1980 Draft WastewaterFacilities Plan and discussions with the Town's Health Agent. The 10 foot contour is based on aerial photography taken in 1990 and converted to GIS format by Applied Geographics Inc. in 1998.

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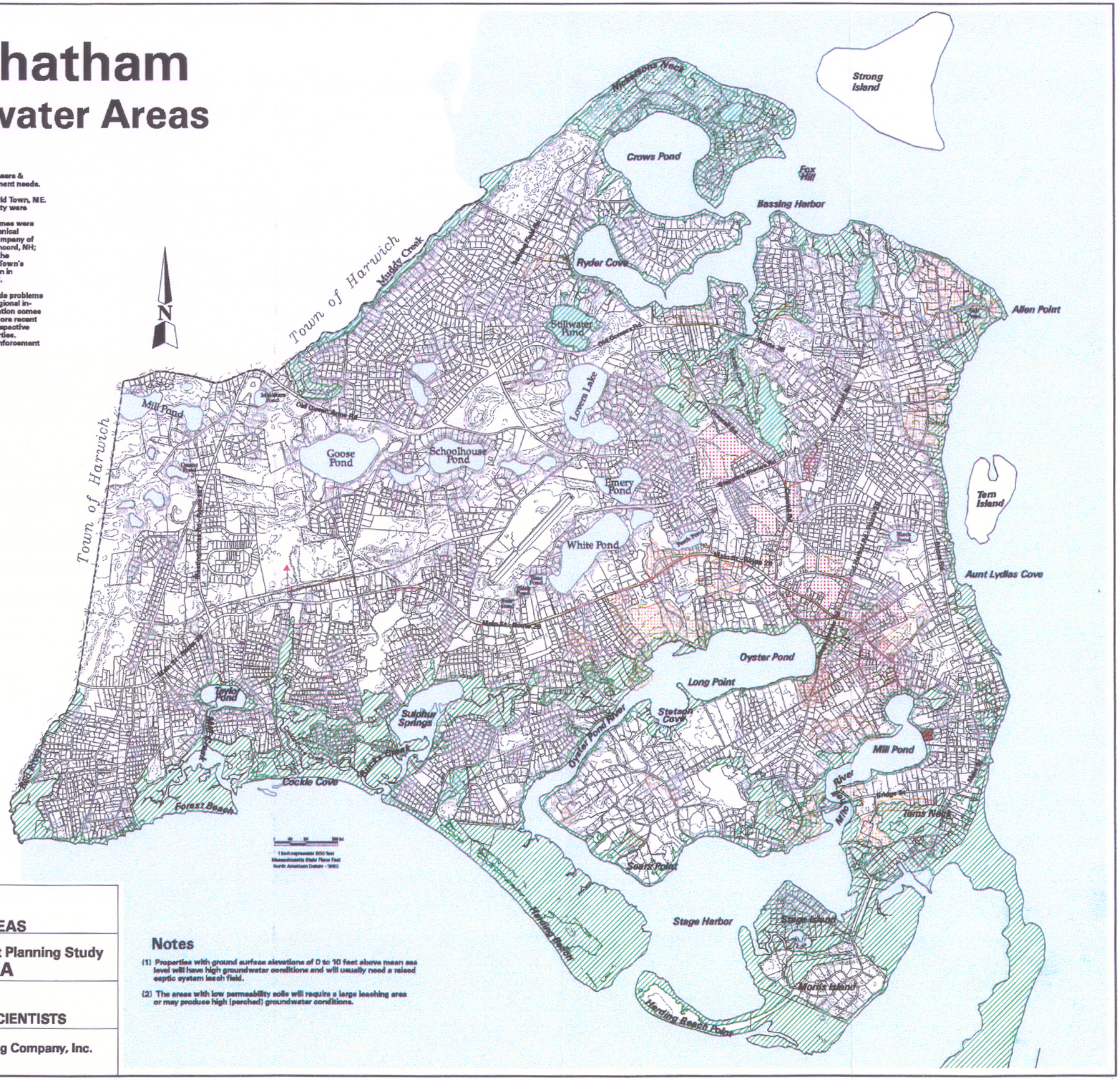

Legend

- Surface Water Bodies
- Sewered Parcels
- Eliphamets Lane Area of Concern
- Areas with Ground Surface Elevations of 0 to 10 feet above Mean Sea Level (1)
- Areas with Low Permeability Soils (2)
- Property Lines
- Sewer Lines
- Coastline (Fresh & Saltwater)
- Town Boundary
- 10 Foot Contour
- Water Pollution Control Facility

Notes

(1) Properties with ground surface elevations of 0 to 10 feet above mean sea level will have high groundwater conditions and will usually need a raised septic system leach field.

(2) The areas with low permeability soils will require a large leaching area or may produce high (perched) groundwater conditions.

FIGURE 4-3
HIGH GROUNDWATER AREAS

Comprehensive Wastewater Management Planning Study
Town of Chatham, MA

Stearns & Wheler, LLC
ENVIRONMENTAL ENGINEERS & SCIENTISTS

Map prepared by Harvard Design and Mapping Company, Inc.

clay layer with limited vertical hydraulic conductivity values from 0.025 to 10 ft/day (EarthTech, 1998).

In 1994, Whitman & Howard simulated groundwater elevations in Chatham based on groundwater measurements taken at 160 observation wells throughout the Town. Groundwater elevations ranged from 0 to 20 feet above MSL.

Low areas of Town can be characterized as having ground surface elevations between zero and ten feet above MSL. These low surface elevations, combined with high groundwater levels of less than 5 feet below the ground surface, are a concern when siting an onsite wastewater treatment system. In many cases, these systems must be elevated to provide sufficient separation between the top of groundwater and the bottom of the soil absorption system.

3. Water Quality. Chatham currently draws its drinking water from the Monomoy Lens. Several studies in Chatham have examined groundwater quality and potential sources of contamination. The majority of these studies have concentrated on Indian Hill Well, which first showed signs of PCE contamination in 1987 (Barnstable County, 1988). Although the source of this contamination was never identified, several potential sources inside the Indian Hill Well's ZOC were listed.

Previous facilities planning reports, and the Monomoy Capacity Study performed by the Cape Cod Commission concentrated on nutrient loadings to the groundwater system from on-site wastewater treatment systems, runoff, fertilizers and other sources. Findings from these reports indicated that the Zone IIs generally remain below 5mg/l nitrate-nitrogen even at build out conditions. The following chapter sections discuss these findings in greater detail.

Groundwater sampling has been performed by Metcalf & Eddy, EarthTech (previously known as Whitman & Howard), Weston & Sampson, and Dufresne-Henry. Groundwater samples were

collected from public and private drinking water wells, and observation wells throughout the Town of Chatham. Groundwater sampling was performed for various reasons including previous facilities planning studies, landfill closures, determination of new drinking water supplies, and examination of existing drinking water supplies.

During the 1982 Facilities Planning Study, groundwater sampling and analysis was performed throughout Chatham. Nitrogen compounds were studied as an indicator of groundwater degradation resulting from the use of onsite subsurface disposal systems. In a study of over 40 wells, nitrate-nitrogen concentrations ranged from <0.04 mg/l to 12 mg/l, with three wells over 5 mg/l and two over 10 mg/l. Sampling was also performed around the existing WPCF infiltration beds. Sixteen wells were analyzed with concentrations ranging from 0.02 mg/l to 17.0 mg/l, with the highest concentrations located closest to the infiltration beds.

As part of the requirements of the Administrative Consent Order issued in 1988, a groundwater monitoring plan was developed to not only examine the groundwater mounding at the WPCF but also the groundwater quality. Following the installation and operation of the Modified Ludzack-Ettinger (MLE) process in April 1996, which is a modification to the conventional activated sludge process for nitrogen removal, there was a reduction in nitrate-nitrogen in the effluent. Groundwater monitoring reports indicated that the nitrate-nitrogen concentrations in wells down gradient of the discharge site, have consistently been below the 10 mg/l standard for Class I groundwaters, which is based on the State's drinking water standard. Prior to the installation of the MLE process, concentrations for nitrate-nitrogen typically exceeded the drinking water standard with concentrations up to 32 mg/l.

In 1988 and 1989, the Barnstable County Health and Environmental Department analyzed groundwater from 10 wells in Chatham. Only two of these wells showed unusually elevated concentrations of organic/inorganic constituents. The Indian Hill Well showed small concentrations of tetrachloroethane (PCE). The other, an observation well located down gradient of the landfill, showed signs of landfill leachate contamination, the most notable being vinyl chloride. The 1989

sampling confirmed the presence of landfill leachate in several wells downgradient of the landfill. This contamination was presumed to be contained in the upper aquifer. In all sampling events, concentrations were below the MCL except the one well, OW#9 located on downgradient edge of the Chatham landfill, in which 7.4 ppb of vinyl chloride was detected.

Following the identification of PCE at Indian Hill Well, several other studies examined this area attempting to identify the source of the PCE contamination. The source was never identified and the PCE concentrations continue to be detected at the Indian Hill Well site.

Groundwater sampling and analysis was also performed at the Chatham Municipal Airport in 1989, as part of a Groundwater Management Plan. Results of this sampling revealed no contaminants of concern in the groundwater at the site.

In 1996, a Comprehensive Site Assessment (CSA) was performed for the Chatham sanitary landfill. Thirteen groundwater monitoring wells were analyzed for various field parameters, inorganics, total metals, and VOCs. Eleven of the wells exceeded the State drinking water standard for pH and manganese, one for nitrate-nitrogen, 13 for iron, seven for lead, two for arsenic and chromium, and three for cadmium. The reports indicate that these results are consistent with landfill leachates and do not pose a wide spread impact on the Town of Chatham's public drinking water supply. Capping of the landfill is expected to reduce these exceedances of the drinking water standard.

In 1997, a prolonged pumping test for test well site 19R-96 (Earth Tech, 1998) was preformed due west of Lovers Lake. Groundwater samples were collected and analyzed for coliform bacteria, inorganic compounds, synthetic organic compounds, volatile organic compounds, radionuclides, secondary contaminants, and other specified DEP compounds. All samples met the drinking water quality standards guidelines. These extensive studies of groundwater in the Town of Chatham indicate that none of the Town's drinking water supplies have been impacted except Indian Hill Well.

4. Public Water Supplies and Existing Zone IIs. The Monomoy Lens is the drinking water source for the Town of Chatham. The Town has seven supply wells located throughout the Town which draw groundwater from this aquifer. The Town is also exploring five more locations as potential well sites to meet future demands. The existing wells are located at four sites throughout Chatham: the South Chatham Well Field, Indian Hill, the Training Field, and Chatham Town Forest. Wells No. 1, No. 2, and No. 3 are located in South Chatham and began operation in 1945, 1949 and 1966 respectfully. Indian Hill Well or well No. 4 began service in 1970. The Training Field Well or well No. 5 was put into service in 1989 just after PCE contamination of Indian Hill Well (Well No. 4) was identified in April of 1988. Since that time the Town has been exploring new well locations or treatment technologies to compensate for, or remediate, the Indian Hill Well water supply. In 1992 and 1993, the Town installed two additional wells in the Chatham Town Forest which are referred to as well No. 6 (Tirrells well) and well No. 7 (Evans well).

The Town investigated eight potential sites for new municipal water supplies and identified the following potential locations:

- Town Forest
- Mill Pond
- Godwin Property
- Training Field
- Frost Fish creek
- High School Property
- Goose Pond
- Training Field Triangle Area

The last three sites were screened out due to poor water quality or poor well yield. The remaining five wells continue to be investigated and/or developed for municipal water supply wells. A new Training Field Well Site (Well No. 8) has received a prolonged pump test, and a Zone II delineation (Earth Tech, 1998). The prolonged pump test for a proposed well at the Town Forest site was performed in May and June 1998, and a report on that test is planned to be released in the near future. The remaining three well sites are still under consideration. All of the Town's municipal

water supply wells are illustrated on Figure 4-4.

Several reports have been developed for the Town of Chatham regarding its Zone II delineations. The latest report, " A Prolonged Pumping Test - Test Well Site 19R-96", Chatham, Massachusetts (Earth Tech, 1998) provided the most up to date Zone II delineations for all the existing Town wells, including the proposed well at Site 19R-96 (Well No. 8). The Zones of Contribution (ZOC) originate in Harwich at the four ponds north of Hawknest State Park and encompass the area to the southeast to Route 28. The ZOCs follow Route 28 east into Chatham to approximately Perch Pond, then north to Stillwater pond, and back west into Harwich and Olivers Pond. These Zone IIs were developed as a result of extensive numerical modeling of the Monomoy lens system based on the various pumping rates for each existing well and the proposed Well No. 8. The perimeter of the Zone II areas in Chatham is illustrated on Figure 4-4.

5. Nitrogen Loading in Zone II Areas. Nitrogen loading to the Towns Zone II areas was performed by the Cape Cod Commission Water Resources Office as part of the Monomoy Capacity Study.

The nitrogen loading analysis was conducted following the Commission's Technical Bulletin 91-001 and utilized several assumptions including: building occupancy, nitrogen concentration, lawn size, roof area, driveway area, wastewater flows, natural recharge rates, run-off concentrations, and fertilizer rate.

Six scenarios were developed to examine the impacts of several growth and build-out factors on nitrogen loading for each of the contributing areas. The six scenarios were:

- Existing Conditions
- Projections for the year 2000
- Projections for the year 2010
- Projections for the year 2015

Town of Chatham
Water Resource Areas

Water Resource Protection Districts
Recharge Areas to Coastal Embayments

This map is being made for Stearns & Wheler LLC. Environmental Engineers & Scientists for the purpose of studying Chatham's wastewater management needs. Parcels were digitized in 1996 from the 1996 assessors maps. Original mylar map linework was delineated by the James Sewall Company of Old Town, ME. Sewered parcels, sewer pipe lines, and the water pollution control facility were digitized in 1990 for the Cape Cod Commission's Regional Policy Plan. The Water Resource Protection Overlay District is from the 3/1/96 map by Earth Tech LTD. The combined (and revised) Zone II area (including site 19R-96 proposed well) is from the 2/98 Earth Tech LTD report on site 19R-96. Watersheds to coastal embayments were automated from lines delineated in 1995 and 1998 by Cape Cod Commission, and from mapping developed by Horsley & Witten, Inc. in the Stage Harbor Comprehensive Harbor Management Plan. Wetlands were digitized in 1991 by the Massachusetts Department of Environmental Protection from maps produced in 1978. Other base map features such as coastlines, water bodies, and road names were automated by the Cape Cod Commission GIS department. Special technical assistance was provided by MassGIS of Boston, MA; the Mapworks Company of Norwell, MA; Earth Tech LTD.; the East Coast Mapping Company of Concord, NH; and the Town of Chatham.

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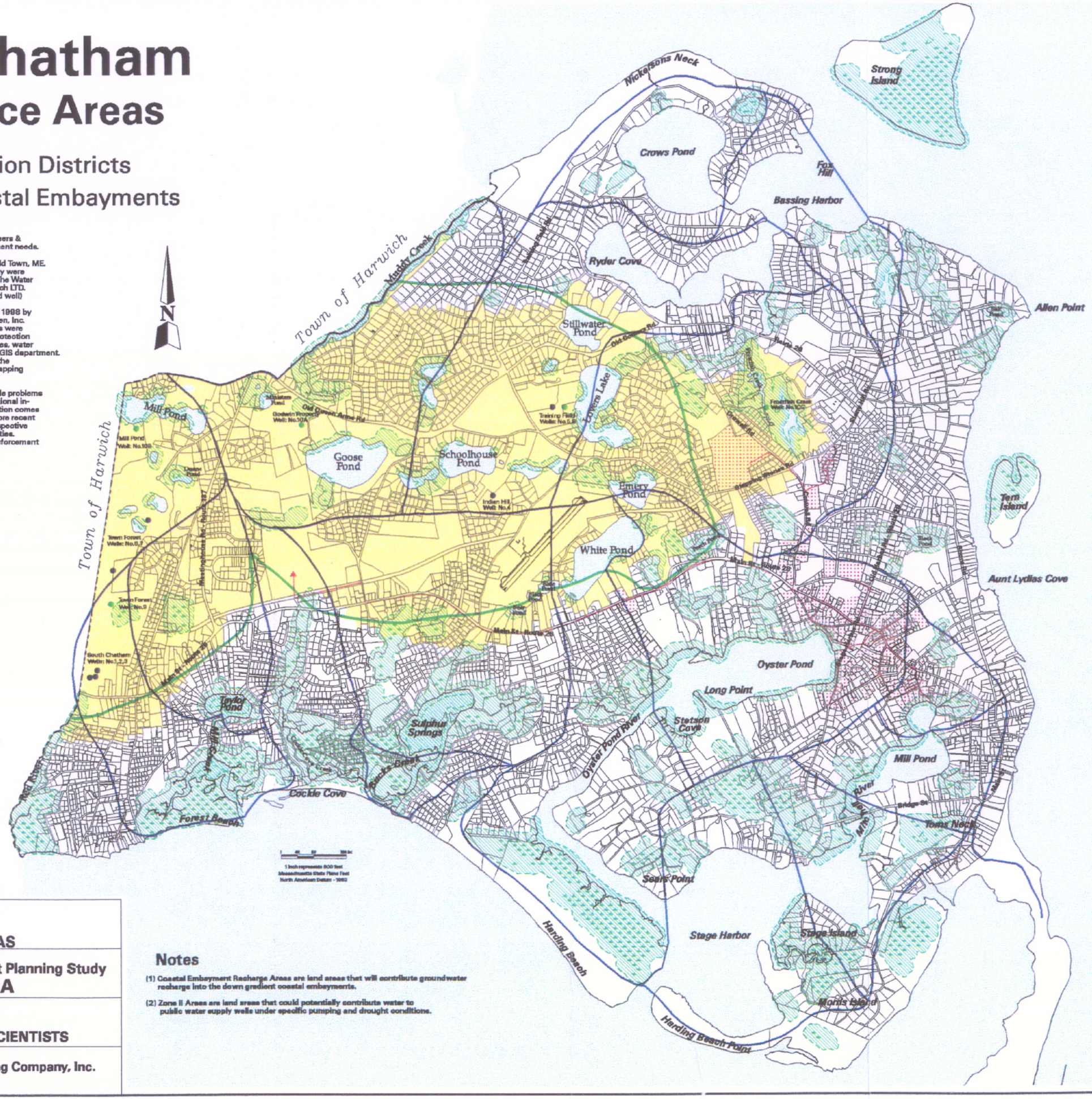


N

Legend

- Wetlands with 100 foot Buffer Area
- Wetlands
- Surface Water Bodies
- Sewered Parcels
- Water Resource Protection Overlay District
- Property Lines
- Sewer Lines
- Coastline (Fresh & Saltwater)
- Town Boundary
- Perimeter of Coastal Embayment Recharge Areas (1)
- Perimeter of Combined (and Revised) Zone II Area Including Site 19R-96 Proposed Well (2)
- Existing Municipal Wells
- Proposed or Future Wells
- Water Pollution Control Facility

Notes

(1) Coastal Embayment Recharge Areas are land areas that will contribute groundwater recharge into the down gradient coastal embayments.

(2) Zone II Areas are land areas that could potentially contribute water to public water supply wells under specific pumping and drought conditions.

FIGURE 4-4
WATER RESOURCE AREAS

Comprehensive Wastewater Management Planning Study
Town of Chatham, MA

Stearns & Wheler, LLC
ENVIRONMENTAL ENGINEERS & SCIENTISTS

Map prepared by Harvard Design and Mapping Company, Inc.

- Year 2015, assuming that 50% of the seasonal housing is converted to year round residences
- Complete build-out, with 100% of housing converted to year round (no seasonal housing).

Results of the nitrogen loading analysis found that Scenarios 5 and 6 were the only ones resulting in nitrogen concentrations exceeding the 5 mg/l threshold established by the Commission. None of the scenarios exceeded the USEPA and Massachusetts DEP Maximum Contaminant Level (MCL) of 10 mg/l. The following table summarizes the results for the different scenarios.

Summary of Nitrogen Loading Analysis Results (mg/l)						
Contributing Area	**1995**	**2005**	**2010**	**2015**	**2015 w/ 50% shift**	**100% build-out**
South Chatham Well Field	3.43	3.97	4.06	4.15	5.09	6.59
Indian Hill Well	2.27	2.58	2.69	2.79	3.58	5.03
Town Forest Wells	1.78	2.27	2.41	2.55	3.11	5.09
Training Field Wells	2.69	2.91	2.98	3.07	3.97	5.48

Data provided by the Cape Cod Commission – Monomoy Capacity Study, 1996

Findings of this report do not indicate a drinking-water quality problem, but the increasing nitrogen loading trend is a concern. Several management options were recommended to further protect the Monomoy lens and help reduce the projected nitrogen loading concentrations. These options included:

- Develop a Water Resource Protection District to limit nitrogen inputs to less than 5 mg/l.

- Install on-site wastewater treatment systems with nitrogen removal capability.
- Town purchase of developable residential lands. The Commission indicated that there

are approximately 400 parcels in Chatham which fall into this category (not including the contributing area which covers Chatham and Harwich properties) and would cost the Town of Chatham between $1,830,000 and $3,050,000 to purchase.

- Sewering and Construction of a centralized treatment facility.

The Town has since developed a Water Resource Protection District to prevent the nitrogen concentration in the Zone II area from exceeding the State limit of 10 mg/l and the Commission's guideline of 5 mg/l. This district is described in the following section. The nitrogen loading analysis indicates that the nitrogen concentration in the public water supply will approach or possibly exceed the 5 mg/l guideline only using the most extreme buildout consumptions. This district will need to be modified in the future to accommodate the construction of new wells and their expanded Zone II areas.

6. Water Resource Protection District. The Town of Chatham approved a Water Resource Protection District at Town meeting in 1996. This district established by the Water Resource Protection District Bylaw, included the existing Zone II areas know at that time; estimates for Zone II areas expected for five proposed wells; and a 200 foot buffer area at the Zone II areas. Zone II areas were estimated at the five well sites based on information gathered from 2.5 inch well test and the following planned pumping rates:

- Training Field (Well No. 8) at 700 gpm
- Town Forest (Well No. 9) at 700 gpm
- Godwin Property (Well No. 10A) at 700 gpm
- Mill Pond (Well No. 10B) at 700 gpm
- Frost Fish Creek (Well No. 10C) at 450 gpm

The Water Resource Protection District was extended to the boundaries of the properties that were

crossed by Zone II areas with few exceptions for site specific considerations. The district was developed prior to the Zone II delineations developed for Well No. 8 (EarthTech, 1998). It will require modifications to account for changes from that Zone II study, as well as, planned Zone II studies for other proposed wells.

As part of the Water Resource Protection District, the Town developed a list of permitted and prohibited uses for properties located within this district. Zoning regulations still govern usage in this district, but specific usage is prohibited as outlined in the Bylaw, Section C Article 5. Some of those prohibited uses include: landfills, new gas stations, non-complying wastewater treatment systems, toxic or hazardous materials generation, storage or disposal facilities, and earth removal within 6 feet of historic high groundwater (except as part of a DEP approved Corrective Action for Waste Site Clean-up).

7. Groundwater Mounding at the WPCF. Hydrogeologic evaluation of effluent discharge at the WPCFs infiltration beds has been performed to characterize the effluent plume and identify its extent and flow direction (M&E, 1982). A two layered aquifer system was identified, separated by a silty clay layer. Effluent from the infiltration beds tended to mound in the upper aquifer then flow southward to Cockle Cove Creek. Little impact to the lower aquifer was detected during the study. The study also evaluated the impact from an increased effluent discharge, one that approached the 440,000 gpd design flow of the WPCF. Model results predicted impacts to several Zone II areas in Chatham. Impacts varied with well-pumping rates and effluent-discharge rates. Further modeling concluded that a effluent discharge rate of 100,000 gpd would not induce flow toward Indian Hill Well or Goose Pond.

In 1988, the Massachusetts DEP issued an Administrative Consent Order (ACO) limiting the effluent discharge from the WPCF to 36,500,000 gallons per year (or an average of 100,000 gpd), and requiring the development of a groundwater monitoring program. The program would track the groundwater mound and make sure it was not impacting any of Chatham's public drinking water supply wells. Since 1988, the groundwater system in the areas of the WPCF has been monitored,

and results indicate no signs of the effluent plume migrating toward the Indian Hill well or any other public drinking water supply well.

Because the Town of Chatham needed to increase the wastewater flow treated at the WPCF and its subsequent effluent discharge, another study was performed to determine the maximum allowable effluent discharge (M&E, 1993). This study determined that the WPCF could discharge up to 135,000 gpd (Indian Hill Well pumping at 800 gpm) and groundwater would continue to flow southward away from the water supply wells.

As a follow-up to that effluent discharge study, varying effluent discharge rates and discharge locations were evaluated at the WPCF site (M&E, 1995). Groundwater modeling and subsequent analysis confirmed the findings of the groundwater mounding test performed in 1993, and this study indicated that the effluent discharge could be increased to an annual average flow of 150,000 gpd average annual with effluent discharge at a new infiltration bed on the south side of the site. Modeling results were based on a reduction of the Indian Hill Well pumping rate to 200 gpm.

The revised Consent Order (see Appendix B) allows the Town to increase WPCF treatment flows to 150,000 gpd.

8. Potential Sources of Drinking Water Contamination. In 1994, a survey of the potential sources of drinking water contamination was performed by Whitman and Howard, Inc. (now called EarthTech, Inc.). A map was produced illustrating the locations of the following potential contamination sources:

- Industrial, commercial, and other land uses.
- Underground storage tanks.
- Locations where underground storage tanks were removed.
- Leaking tanks.
- Location where a leaking tank was removed.

- Chemical or fuel spill sites.
- RCRA facility sites.
- 21E sites.
- Wastewater treatment facilities.

This map has been used to manage the Town's water supplies and to locate potential new well sites.

D. Fresh Surface Waters

1. Introduction. The Town of Chatham contains no navigable freshwater streams or rivers, but does contain several freshwater ponds. There are 15 fresh water ponds in Chatham, most of which are located to the west of the Route 28 loop. The Commonwealth of Massachusetts defines any pond larger than 10 acres as a Great Pond. Of the 15 ponds in Chatham, seven fit this description. These ponds are (from largest to smallest): Goose Pond, Lovers Lake, White Pond, Mill Pond, Schoolhouse Pond, Stillwater Pond and Emery Pond. Table 4-1 summarizes the Great Ponds in Chatham. It is also noted that only three of these ponds (Goose Pond, Schoolhouse, and White Pond) have public access. There are also eight small ponds that include: Ministers, Duane, Mary's, Black, Blue, Perch, Ryders, and Bearses.

The majority of the ponds in Chatham were formed as a result of the receding glacial movements across Cape Cod. As the glaciers receded, chunks of ice broke off and were buried by glacial outwash. When the ice melted it formed what are known as kettle holes or glacial lakes. Some of the more prominent of these kettle holes are: Goose Pond, White Pond, Lover's Lake and Schoolhouse Pond.

2. Water Quality. Water quality of the ponds is good, but the amount of existing information on these ponds is limited. The pond waters are typically acidic due to the acidity of the rain water and minimum buffering capacity of the Town's soils. Robert Duncanson, Ph.D., of the Chatham Water Quality Laboratory, has indicated that the water quality of ponds in Chatham is very

TABLE 4-1

SUMMARY OF CHATHAM PONDS
Comprehensive Wastewater Management Planing Study
Town of Chatham, Massachusetts

Pond Name	Surface Area (acres) [1]	Maximum Depth (ft)	Shoreline (ft)
Goose Pond	38	52 [(2)]	4,600 [(2)]
Lover's Lake	36	NA	NA
White Pond	36	NA	NA
Mill Pond	22	NA	NA
Schoolhouse Pond	21	47 [(2)]	3,500 [(2)]
Stillwater Pond	18	NA	NA
Emery Pond	11	NA	NA

Notes:
1. Data provided by Chatham: Open Space and Recreation Plan, 1985
2. Date provide by DEP:Baseline Water Quality Studies of Selected Lakes and Ponds in the Cape Cod Drainage Area, 1984.

NA - Data Not Available

good and is not a concern at this time. Minimal water quality sampling has been initiated by the Town due to its good quality.

The seven Great Ponds were sampled between 1975 and 1976 for nitrate-nitrogen, ammonia-nitrogen, phosphate-phosphorous, specific conductance, chlorides, total coliform, fecal coliform, and chlorophyll a (M&E, 1982). In addition to these analyses, three ponds: Goose, White, and Lover's Lake were analyzed between 1976 and 1980 for nitrate-nitrogen, ammonia-nitrogen, specific conductance, phosphate, and chloride (M&E, 1982). These two sets of sample results are included in Appendix C.

A more in-depth study was performed by the Massachusetts DEP (known at that time as DEQE) in 1984 on Goose Pond and Schoolhouse Pond. Each pond's location, watershed, water quality, recreational usage, and aquatic and physical characteristics were outlined. Table 4-2 and 4-3 summarize this information.

The Living Lakes program also performed a study of Schoolhouse Pond between 1986 and 1991. The study examined the impacts of liming the pond to support fish stocking. Numerous surface water samples were collected and analyzed to study the effects. The analyzes included: pH, DO, conductivity, nitrate-nitrogen, ammonia-nitrogen, total nitrogen, total phosphorus, and various metal. These results are also located in Appendix C.

Neither the M&E, DEP, nor Living Lakes report's sampling results showed any excessive amounts of nutrients in the surface waters. High nutrient levels and visible signs of eutrophication are indicators of possible man-made impacts on these waters. The majority of these ponds have little or no public access ways, and this limits the ability of the Town to adequately monitor them on a regular basis.

TABLE 4-2

PHYSICAL CHARACTERISTICS [1] OF
GOOSE AND SCHOOLHOUSE PONDS
Comprehensive Wastewater Management Planing Study
Town of Chatham, Massachusetts

Parameter	Goose Pond	Schoolhouse Pond
Maximum Length (ft)	1,950	1,400
Maximum Width (ft)	1,175	850
Maximum Depth (ft)	52	47
Mean Depth (ft)	23	20
Mean Width (ft)	770	578
Area (acres)	34.5	18.62
Volume (acre-ft)	801	377
Shoreline (ft)	4,600	3,500

Notes:
1. Data from DEP report on Baseline Water Quality Studies of Selected Lakes and Ponds in Cape Cod Drainage Area, 1984

.

TABLE 4-3

WATER QUALITY DATA [1] FOR
GOOSE AND SCHOOLHOUSE PONDS
Comprehensive Wastewater Management Planing Study
Town of Chatham, Massachusetts

	Goose Pond Sample Locations			Schoolhouse Pond Sample Locations	
Parameter	**Surface**	**26 ft deep**	**36 ft deep**	**26 ft deep**	**36 ft deep**
pH	6.7	6.6	6.4	6.2	5.9
Total Alk., mg/l	6	8	10	2	5
Total Hard., mg/l	18	20	18	15	13
SS, mg/l	1.0	1.5	1.0	0.0	0.0
Total Solids, mg/l	200	196	244	132	156
SC (umhos/cm)	100	110	100	120	90
Chloride, mg/l	18	18	19	18	19
NH4-N, mg/l	0.04	0.12	0.36	0.01	0.02
NO3-N, mg/l	0.2	0.1	0.2	0.0	0.0
TKN, mg/l	0.42	0.47	0.68	0.35	0.42
Total P, mg/l	0.04	0.04	0.04	0.2	0.04
Total Iron, mg/l	0.04	0.06	0.26	0.0	0.23
Total Mn, mg/l	0.03	0.04	0.25	0.02	0.1

Notes:
1. Data from DEP report on Baseline Water Quality Studies of Selected Lakes and Ponds in Cape Cod Drainage Area, 1984.

Chatham receives its drinking water from the Monomoy Lens and therefore does not use these ponds for drinking water supplies. Since these ponds are connected the to groundwater system, there are concerns of impacts from onsite septic system effluent, runoff and other man-made influences. These freshwater ponds have been identified as Class B in 314 CMR 4.06. The following ponds have also been classified as Outstanding Resource Waters in 314 CMR 4.06: Stillwater Pond, Lover's Lake, Mill Pond, and Ministers Pond. The Class B status of these ponds is the highest water quality standard established for surface waters not used as a drinking water source. Class B waters are designated as a habitat for aquatic life, wildlife, and for primary and secondary contact recreation (i.e. boating and swimming). Ponds classified as Outstanding Resource Waters are those which are defined as having outstanding socio-economic, recreational, ecological and/or aesthetic value to the Commonwealth of Massachusetts.

A primary concern to water quality in fresh surface water is phosphorus contained in septic system or wastewater treatment facility discharges. Phosphorus is typically the limiting nutrient in these waters; therefore, aquatic algal growth is limited by the amount of phosphorus available in the water. The nitrogen concentration in these waters is typically not a concern because it is not the limiting nutrient. Unlike nitrogen, phosphorus does not travel far in the groundwater system and is attenuated in the soils; therefore, phosphorus discharges in the majority of the recharge area to the ponds does not cause a concern. Phosphorus discharge within 300 feet of a fresh water pond may cause an impact to the pond depending upon the type of soils around the pond. As a result of this potential phosphorus travel distance, the Cape Cod Commission Regional Policy Plan includes Minimal Performance Standard 2.1.1.2.B.1 that states:

> "In order to limit phosphorus inputs, no subsurface disposal systems shall be permitted within 300 feet of mean high water of fresh water ponds unless the applicant demonstrates by a ground water study that the site is not within the Fresh Water Recharge Area."

Discussions with the Cape Cod Commission Water resources staff indicate that a setback of 300 feet is appropriate for the sandy soil of Cape Cod based on research at various Cape Cod ponds and research documented in an USEPA study (W. Rask and F. Lee, 1975).

This standard is expected to protect the water quality of the Town's ponds from future development and could be adopted for new development around fresh water ponds.

A 300-foot setback around the Town's fresh water ponds is illustrated on Figure 4-1.

The good water quality of the Town's ponds indicates that existing development is not currently impacting the ponds.

E. Coastal Embayments.

1. Introduction. The Town of Chatham is bordered to the south by Nantucket Sound, the east by Chatham Harbor and the Atlantic Ocean, and the north by Pleasant Bay. Each of these major surface saltwater bodies help form the coastal embayments for which Chatham is known. Chatham's coastal embayments are one of the Town's most valuable resources. They support a valuable shellfishing industry, which provides year-round jobs; they provide scenic beauty and recreational areas, which have created the Town's vacation and tourist industry.

The Town's coastal embayments are divided into the following three logical groupings based on their geographic location, the watersheds in which they are located, and the previous studies on these embayments:

- Pleasant Bay.
- Stage Harbor.
- South Coast Embayments.

2. Nitrogen Sensitivity. Coastal embayments are sensitive to nitrogen inputs because nitrogen is typically the limiting nutrient in these surface water systems. This means that coastal waters have more than enough phosphorus and other nutrients to fertilize marine plants, and the growth of these marine plants is limited by the nitrogen content in the water. Therefore, as more nitrogen is added to the system, more plant material is produced. As more plant material is produced, the water quality can be impacted.

Nitrogen enters a coastal embayment through its recharge area (watershed). The nitrogen originates from on-site septic systems; discharges from wastewater treatment plants; fertilization of lawns and agricultural lands; waterfowl; wetlands; atmospheric deposition and stormwater runoff from impervious surfaces. Wastewater treatment plants are currently designed to remove nitrogen, therefore, the discharge of treated wastewater from wastewater treatment plants have lower nitrogen concentration than discharge from individual septic systems. Typical Title 5 approved systems provide minimal nitrogen removal, and are usually the largest source of nitrogen to coastal embayments. Typical Title 5 approved systems can be upgraded to remove nitrogen, and these systems are often called "Title 5 Plus Systems".

The assimilative capacity of a coastal embayment is a function of its depth and tidal flushing characteristics, and is unique to each embayment. Often coastal embayments are impacted by average embayment nitrogen concentrations as low as 0.35 mg/l. This is considerably lower than the State drinking water standard of 10 mg/l. The assimilative capacity must be determined for each embayment through a nitrogen loading assessment.

3. Nitrogen Loading Assessment Methodology and General Information.

a. **Assessment Methodology.** Nitrogen loading assessments are typically comprised of the following components.

- Identification of the water quality standards and appropriate goals that are desired for the embayment.

- Determination of embayment flushing rates (local residence time) to understand how long the water stays within the embayment before it is flushed to a larger water body where there is relatively pristine (background) water quality.

- Calculation of the embayment nitrogen assimilative capacity (critical nitrogen loading) based on water quality standards and local residence time. This calculation typically uses procedures developed by the Buzzards Bay Project (USEPA & MAEOEA, 1991) and State surface water quality standards. The calculation can also use water quality concentration standards and a mass balance approach. Both calculations were performed for Chatham's embayments.

- Delineation of the watershed that contributes surface and groundwater to the embayment or subembayment.

- Calculation of existing and future nitrogen loading in the watershed to indicate the mass of nitrogen that is introduced to the embayment with the normal groundwater recharge.

- Consideration of nitrogen interception by wetland systems through which the groundwater (with its soluble nitrogen content) must flow before it recharges into the embayment.

- Comparison of current and future nitrogen loading to critical nitrogen loading to determine if nitrogen management alternatives should be identified and evaluated.

b. Water quality standards for Chatham's coastal embayments. Massachusetts has adopted a coastal surface water classification system in the regulations of 314 CMR 4. This system identifies four types of coastal waters: SA, SB, SC, and Outstanding Resource Waters (ORW). These classifications have limited numerical water quality criteria (dissolved oxygen, temperature, pH, solids, solar and turbidity, oil and grease, and taste and color) that tend to focus on impacts from point source wastewater discharges. These criteria do not include nitrogen, which is the primary source of coastal over fertilization (eutrophication). The criteria from the regulations are summarized below.

STATE COASTAL WATERS CLASSIFICATION SYSTEM FROM 310 CMR 4.05 (4)	
Classification	**Criteria**
SA	- "suitable for shellfish harvesting without depuration" - "excellent habitat for fish, other aquatic life and wildlife and for primary and secondary contact recreation" - "have excellent aesthetic value"
SB	- "suitable for shellfish harvesting with depuration" - "habitat for fish, other aquatic life and wildlife and for primary and secondary contact recreation" - "have consistently good aesthetic value"
SC	- "habitat for fish, other aquatic life and wildlife and for secondary contact recreation" - have good aesthetic value" - "suitable for certain industrial cooling and process uses"
The ORW designation can be added to any water classified under the SA/SB/SC system. These waters are recognized as being "an outstanding resource as determined by their outstanding socio-economic, recreational, ecological and/or aesthetic values. The quality of these waters shall be protected and maintained." Degradation of these waters is not allowed unless authorized by the Director of the State Division of Water Pollution Control.	
This table is adapted from a table and text in the "Pleasant Bay Nitrogen Loading Study" (CCC, 1998.)	

All of the coastal surface waters in Chatham are classified as SA. Pleasant Bay embayments have the additional ORW designation because Pleasant Bay is adjacent to the Cape Cod National Seashore, and is designated as an Area of Critical Environmental Concern (ACEC). Though these classifications do not include nitrogen standards, the Buzzards Bay Project has developed a calculation methodology to determine assimilative capacity (critical nitrogen loading values) based on the State classifications. This methodology is presented in a following chapter section.

Surface water nitrogen standards can also be developed based on the total nitrogen concentration that is allowed in the embayment. These allowed concentrations are then compared with existing measured concentrations to determine if the concentration is being exceeded or if additional nitrogen can be accommodated by the embayment.

The Town of Falmouth is the only Town on Cape Cod that has identified nitrogen concentration standards for its embayments (Falmouth Zoning Bylaw Article XXI). The following goals and standards are identified in the Bylaw.

- High Quality Areas: "Areas designated as High Quality Areas shall be provided the highest level of protection. These estuaries areas support high quality shellfish and areas of high scenic and esthetic quality". These areas have a water quality total nitrogen standard of 0.32 ppm.

- Stabilization Area: "Areas designated as Stabilization Areas shall allow higher nitrogen loading than High Quality Areas if those loadings when combined with public and private capital improvements in a comprehensive program, including dredging, channel openings, drainage improvements, animal control, upgrading of septic systems as necessary, etc., would eventually improve water quality in those areas to a point higher than the established standard." These areas have a water quality total nitrogen standard of 0.52 ppm.

- Intensive Water Activity Areas: "Areas designated as Intensive Water Activity Areas are set aside for the most intensive land uses and active water uses where esthetic quality is the

principal water quality concern. Water quality standards shall be the least stringent in these areas to accommodate planned growth and development." These areas have a water quality total nitrogen standard of 0.75 ppm.

These three classifications and standards tend to parallel the State's classifications of SA, SB, and SC. They are based on water quality sampling and Falmouth's decision on acceptable water quality for particular embayments. They are also based on a background total nitrogen concentrations of approximately 0.3 ppm in Buzzards Bay and Nantucket Sound. The background nitrogen concentration in the Atlantic Ocean and Pleasant Bay is believed to be approximately 0.1 ppm (CCC, 1998). The background concentration in Nantucket Sound off Stage Harbor was recently (October 28, 1998) measured at approximately 0.3 ppm.

The Cape Cod Commission has reviewed the Buzzards Bay Project (BBP) calculation methods and Falmouth Pond Watchers data, and determined that the ORW State classification (in combination with BBP methodology) equates to a 0.1 part per million (ppm) total nitrogen increase over background concentrations. The Commission refers to this standard as the BBP ORW standard. They have also determined that the SA classification (in combination with BBP methodology) equates to 0.2 ppm total nitrogen increased over background concentrations. This is referred to as the BBP SA standard. The Commission has also reviewed the Falmouth Pond Watcher's data and efforts, and have identified additional concentration standards based on total nitrogen increases of 0.05 and 0.15 ppm to provide further options to communities that want to protect their embayments. The four concentration standards are listed below.

- "The Outstanding Resource Water – Nitrogen" (ORW-N) standard represents an increase of 0.05 ppm above the background concentration.

- "The Buzzards Bay Project Outstanding Resource Water" (BBP ORW) standard represents an increase of 0.1 ppm above the background concentration.

- The SA-N standard represents an increase of 0.15 ppm above the background.

- The "Buzzards Bay Project SA" (BBP SA) standard represents an increase of 0.2 ppm above the background concentration.

Critical nitrogen loading values are developed for all of the standards to illustrate the difference between the sets of standards. It is noted that these standards are typically multiples of each other due to the concentration limits on which they are based.

The Town of Chatham should review these nitrogen loading standards to identify the standard that best meets the Town's goals and can be agreed to by all parties. An excerpt form the Cape Cod Commission's Coastal Embayment Report (CCC, 1998b) is included in Appendix D to provide further background on these standards.

Water quality sampling of the embayments and background water quality will be needed to understand the background concentrations and to select an appropriate concentration standard.

c. Embayment flushing characterization. The critical nitrogen loading is a function of depth and tidal flushing. Deep embayments, and embayments that have a high tidal range and a large exchange of ocean water can typically assimilative more nitrogen, and will have a higher critical nitrogen loading value. A flushing analysis must be performed on each embayment to calculate high tide volume, low tide volume, tidal prism volume (the volume that is flushed during each tidal cycle), and residence time. This is typically accomplished by a bathymetric survey of the embayment, data collection through the use of tide gauges, and hydrodynamic computer modeling.

The tidal flushing in the Pleasant Bay embayments was characterized as part of the recently completed Pleasant Bay Resource Management Plan. Aubrey Consulting, Inc. (ACI) summarized their findings in their 1997 report (ACI, 1997), which were incorporated into the Cape Cod Commission's Nitrogen Loading Study (CCC, 1998b). These findings were later incorporated into

the Pleasant Bay Resource Management Plan (Pleasant Bay TAC et al, 1998). This study evaluated tidal flushing and the potential tidal flushing that would result if the New Inlet to Pleasant Bay were to close up. Their findings on tidal flushing and nitrogen loading are attached in Appendix E and are discussed later in this chapter section.

The tidal flushing in Stage Harbor and its embayments was characterized in the early 1990's by ACI and summarized by Horsley Witten Hegemann, Inc. (HWH) in the 1992 Comprehensive Harbor Management Plan (HWH, 1992). This work was later revised by ACI as part of the Comprehensive Wastewater Management Planning Study as described in letters from ACI in Appendix F. These revisions provide significant changes to the earlier work indicating that the State Harbor embayments have greater flushing, and therefore, have greater nitrogen assimilative capacity. This is described later in this chapter.

The tidal flushing in the South Coast Embayments of Taylor Pond, Mill Creek, Sulfur Springs, and Bucks Creek was evaluated by Applied Science Associates (ASA) as part of the Comprehensive Wastewater Management Planning Study. Their findings are attached in Appendix G.

d. Critical nitrogen loading calculation. The Buzzards Bay Project (BBP) has developed methodology to calculate the nitrogen assimilative capacity of an embayment (critical nitrogen loading) based on the flushing characteristics, depth, and the State classification of coastal waters. The methodology was presented in the "Comprehensive Conservation and Management Plan for Buzzards Bay" (USEPA and EOEA, 1991). The methodology is based on the following limits.

BUZZARDS BAY PROJECT, NITROGEN LOADING LIMITS			
EMBAYMENT	**ORW**	**SA**	**SB**
Shallow			
- flushing: 4.5 days or less	100 $mg/m^3/Vr$	200 $mg/m^3/Vr$	350 $mg/m^3/Vr$
- flushing: greater than 4.5 days	$5/g/m^2/yr$	$15/g/m^2/yr$	$30/g/m^2/yr$
Deep	130 $mg/m^3/Vr$		
- select rate resulting in lesser annual loading	130 $mg/m^3/Vr$ 10 $g/m^2/yr$	260 $mg/m^3/Vr$ 20 $g/m^2/yr$	500 $mg/m^3/Vr$ 45 $g/m^2/yr$
Note: Vr = Vollenweider flushing term; Vr = r/(1 + sqrt (r); r = flushing time (yrs.) Source: USEPA and MA EOEA, 1991, and Cape Cod Commission, 1998.			

These limits were used to calculate critical nitrogen loadings for the BBP ORW and BBP SA standards as summarized in following chapter sections.

The critical nitrogen loading has also been calculated based on the concentration limits of ORW-N and SA-N. These are calculated based on the tidal prism volume, 1.93 tidal prism volumes being exchanged per day, and the increase in nitrogen allowed by the concentration increase described for these standards. Results for these calculations are summarized in following chapter sections for each of the embayments.

e. Embayment watershed delineation. The Pleasant Bay Resource Management Plan and the Comprehensive Harbor Management Plan both developed coastal embayment recharge areas for the Pleasant Bay and Stage Harbor areas. In addition, the Commission developed coastal embayment recharge areas for the Town in 1995 based on groundwater elevation and flow direction developed in previous Town studies. These coastal embayment recharge areas are illustrated in Figure 4-5.

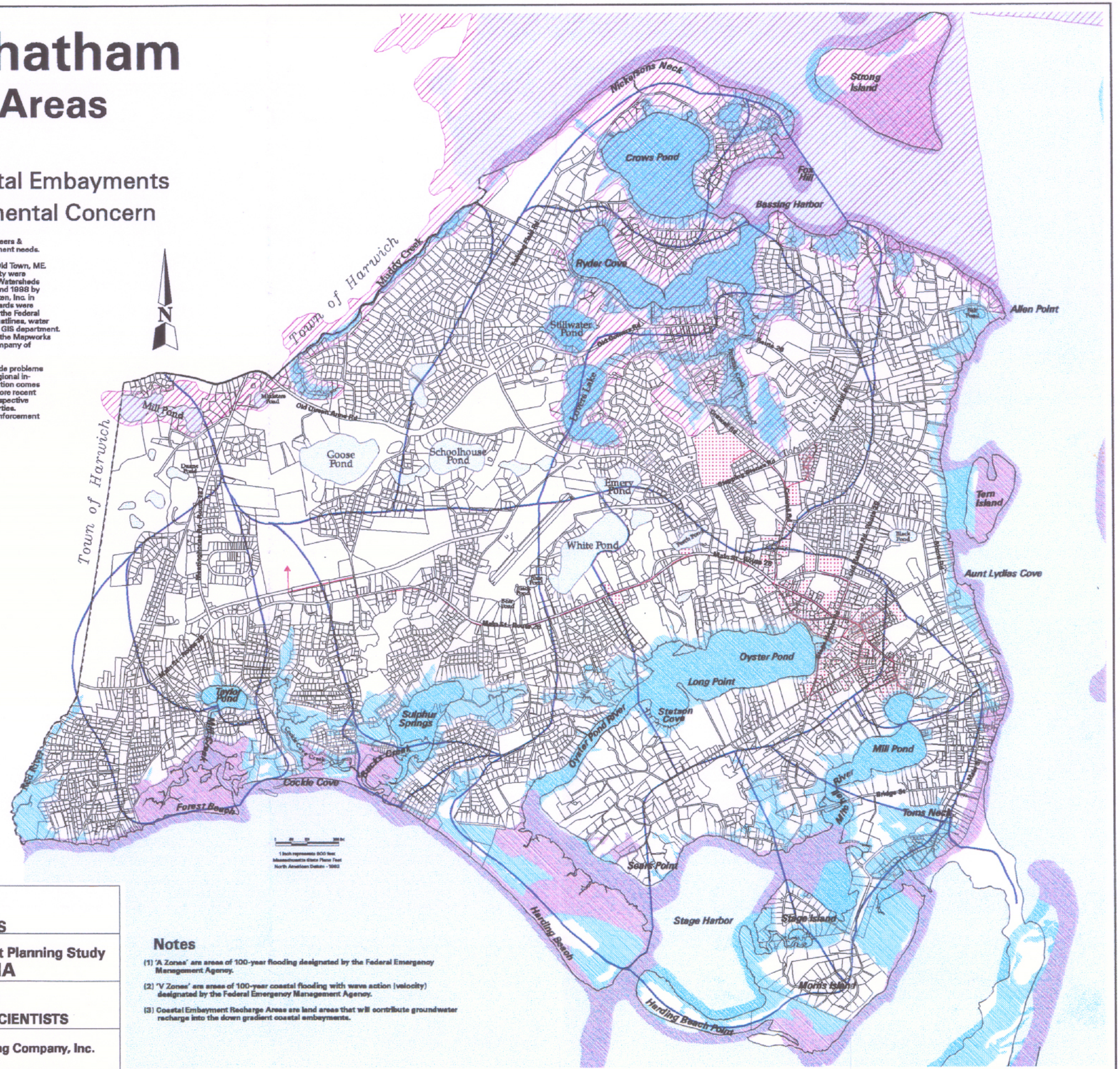
Town of Chatham

Coastal Issue Areas

100 Year Flood Zones
Recharge Areas to Coastal Embayments
Area of Critical Environmental Concern

This map is being made for Stearns & Wheler LLC, Environmental Engineers & Scientists for the purpose of studying Chatham's wastewater management needs. Parcels were digitized in 1996 from the 1996 assessors maps. Original mylar map linework was delineated by the James Sewall Company of Old Town, ME. Sewered parcels, sewer pipe lines, and the water pollution control facility were digitized in 1990 for the Cape Cod Commission's Regional Policy Plan. Watersheds tocoastal embayments were automated from lines delineated in 1995 and 1998 by Cape Cod Commission, and from mapping developed by Horsley & Witten, Inc. in the Stage Harbor Comprehensive Harbor Management Plan. Flood hazards were digitized in 1991 from the 1990 Flood Insurance Rate Map produced by the Federal Emergency Management Agency. Other base map features such as coastlines, water bodies, and road names were automated by the Cape Cod Commission GIS department. Special technical assistance was provided by MassGIS of Boston, MA; the Mapworks Company of Norwell, MA; Earth Tech LTD.; the East Coast Mapping Company of Concord, NH; and the Town of Chatham.

This map has been developed as a planning tool to investigate town-wide problems related to wastewater treatment and disposal. Much town-wide and regional information has been integrated to produce this map. The source information comes from a variety of dates, as noted above, and therefore may not reveal more recent changes. Also, the source information was digitized with a regional perspective and this may show inherent inaccuracies pertaining to individual properties. This map does not intend to provide design information or regulatory enforcement for individual properties.



Legend

- A Flood Zone (1)
- V Flood Zone (2)
- Surface Water Bodies
- Sewered Parcels
- Area of Critical Environmental Concern (ACEC)
- Property Lines
- Sewer Lines
- Coastline (Fresh & Saltwater)
- Town Boundary
- Perimeter of Coastal Embayment Recharge Areas (3)
- Water Pollution Control Facility

1 inch represents 800 feet
Massachusetts State Plane Feet
North American Datum - 1983

Notes

(1) 'A Zones' are areas of 100-year flooding designated by the Federal Emergency Management Agency.

(2) 'V Zones' are areas of 100-year coastal flooding with wave action (velocity) designated by the Federal Emergency Management Agency.

(3) Coastal Embayment Recharge Areas are land areas that will contribute groundwater recharge into the down gradient coastal embayments.

FIGURE 4-5
COASTAL ISSUE AREAS

Comprehensive Wastewater Management Planning Study
Town of Chatham, MA

Stearns & Wheler, LLC
ENVIRONMENTAL ENGINEERS & SCIENTISTS

Map prepared by Harvard Design and Mapping Company, Inc.

Twelve subembayment recharge areas were identified for Pleasant Bay, five that are located inside Chatham. These five recharge areas are identified by their subembayments and include Ryders Cove, Crows Pond, Frost Fish Creek, Bassing Harbor, and portions of Muddy Creek.

The Comprehensive Harbor Management Plan (HWH, 1992) delineated five recharge areas for the Stage Harbor area, which drain Oyster Pond, Oyster River, Stage Harbor, Mitchell River, and Mill Pond/Little Mill Pond. These delineations were based on natural divisions and groundwater elevations found in this area. The delineations for the Stage Harbor Complex were modified slightly to identify a separate recharge area for Little Mill Pond, and to extend the northern limits of the Oyster Pond and Oyster Pond River Watersheds northward to meet the groundwater divide line delineated by the Cape Cod Commission.

Recharge areas were delineated for Taylors Pond, Mill Creek, Sulfur Spring, Bucks Creek, and Cockle Cove Creek embayments and drainage areas by the Cape Cod Commission based on groundwater elevations, developed in previous Town studies.

As mentioned above, the delineations are based on available groundwater elevations, surface contours and an understanding of Chatham's hydrogeology. Chatham's hydrogeology is very complex with its upper and lower aquifer, and areas of low permeability soils. Determining the exact delineation of a particular embayment would require extensive hydrogeologic investigation. The coastal embayment recharge area delineations may be utilized in the future to establish new Protective Water Resource Districts similar to the Water Resource Protection District used for the Zone II areas. New overlay districts (and associated restrictions to land use or wastewater discharge) could have a large financial impact to properties located in these areas. Nitrogen loading from these watersheds to the individual subembayments is discussed in following sections.

f. Calculation for existing nitrogen loading within embayment watersheds.

The existing nitrogen loading within each subembayment watershed was calculated based on approved procedures developed by the Cape Cod Commission and used in the Pleasant Bay

Resource Management Plan. The basis for these procedures is the Cape Cod Commission's Technical Bulletin 91-001, which presents nitrogen loading factors for these analyses.

The wastewater nitrogen loadings from on-site systems were developed based on the following factors.

- Population data (Technical Bulletin 91-001).
- Title 5 design flow and wastewater nitrogen concentrations of 35 ppm.
- Actual and average water flow data for Chatham and wastewater nitrogen concentrations of 35 ppm.

Calculation of nitrogen loading based on water consumption is believed to be the most accurate because wastewater is generated from the water flow. Accurate water flow data is often difficult to obtain and this Comprehensive Wastewater Management Planning Study has taken much effort to enter this data into the GIS for these wastewater nitrogen loading calculations.

The non-wastewater nitrogen loadings were developed based on the following factors from Technical Bulletin 91-001.

- Road runoff concentrations of 1.5 ppm and road areas available in the Geographic Information System (GIS).

- Roof runoff and direct precipitation on embayment concentrations of 0.75 ppm and the surface areas for these locations available from the GIS.

- Natural area runoff concentration of 0.05 ppm.

- Average lawn size of 5,000 square feet, nitrogen fertilizer rates of 3 lb/1000 sq. ft, and 25 percent of applied fertilizer recharging to the groundwater system.

- Precipitation recharge rates of 40-inches on impervious surface and 16-inches for lawn and natural areas.

These factors are based on previous studies on Cape Cod and nationally.

g. Consideration of nitrogen interception by wetland systems. The potential benefits of wetlands to intercept and denitrify nitrogen from groundwater recharge is currently being studied by researchers as nitrogen loading to coastal embayments is becoming more of a national concern. A review of available literature and an understanding of denitrification in natural systems illustrate the following points.

- Wetland systems are documented to intercept and remove nitrogen through denitrification and plant uptake during the summer.

- Wetlands produce nitrogen, which is released to the environment as plant material decays. Wetlands have been documented as net nitrogen producers (Nixon and Lee, 1986).

- An organic carbon source such as wetland peat or pond sediments is needed in combination with nitrate nitrogen for denitrification to occur.

- Wetland peat and pond sediments will tend to be less permeable than underlying sands in Chatham, therefore, the groundwater will tend to be directed away from these organic carbon sources, and denitrification will not occur.

At this time, it is not possible to definitely state that wetlands (particularly fringing salt mash wetlands) can remove specific percentages of nitrogen in groundwater recharge. Some of the recharge areas may have greater potential to denitrify groundwater recharge due to their wetland characteristics. The fresh and salt water wetlands in the Cockle Cove Creek Watershed may have

the highest potential for interception of groundwater nitrogen because of its long length and freshwater characteristics.

4. Pleasant Bay Embayments.

a. Identification. The Pleasant Bay system is a large estuary located in parts of four Cape Cod towns. The towns that encircle the bay are: Chatham, Harwich, Orleans, and Brewster. The Pleasant Bay estuary system covers over 7,000 acres, including salt and freshwater ponds, rivers, saltmarsh, barrier beaches, and eight small islands. There are over 70 miles of shoreline associated with the bay (Pleasant Bay TAC, 1998). Chatham borders the lower portion of the bay and has five subembayments: Ryder's Cove, Crows Pond, Bassing Harbor, Frost Fish Creek, and a portion Muddy Creek (the other portion is in Harwich).

Chatham Harbor, the entrance way to Pleasant Bay, is also located in the Town of Chatham. In 1987, the entrance to Chatham Harbor shifted northward as stormwaters broke through Nauset Beach and created what is now known as New Inlet. The significance of this change is that the flushing characteristics and tidal flux to Pleasant Bay was altered. This alteration increased the flushing in Pleasant Bay and increased the tidal range by 1 foot. The increased flushing reduced the residence time in the bay, helping improve the overall water quality.

b. Previous studies. Three major reports have been developed regarding the Pleasant Bay estuary. In 1997, Aubrey Consulting, Inc. prepared a hydrodynamic and tidal flushing study (ACI, 1997). The Cape Cod Commission performed a nitrogen loading analysis in 1998 (CCC, 1998). Shortly afterward, a Final Pleasant Bay Resource Management Plan was prepared by the Pleasant Bay Technical Advisory Committee (Pleasant Bay TAC, 1998). These reports provide the most comprehensive information on the Pleasant Bay estuary. Findings of these reports are presented in the Needs Assessment Report.

c. Uses. Pleasant Bay provides a number of natural, cultural, and recreational

resource to the area. The bay has several public and private landings, piers and marinas. Of the 1,383 total moorings on the Bay, 616 are located in Chatham along with 45 docks, and 14 marine landings or access points. The Fish Pier is a municipally owned facility, which provides services to the commercial fishing and shellfishing fleet, and two local seafood companies. The pier also serves as a tourist attraction, providing up-close viewing of the fish processing operations and the off-loading of catches (Pleasant Bay TAC, 1998). Pleasant Bay is also often referred to as one of the most popular sport fishing area in the Commonwealth.

Harbor water uses include tourism, transportation, recreational uses, fishing (both commercial and recreational), and other commercial uses.

d. Results of nitrogen loading assessment. The increased flushing of the Bay has improved water quality, but impacts to the smaller estuaries and subembayments connected to the Bay still experience water quality problems. An inlet restriction where Route 28 crosses Muddy Creek and Frost Fish Creek produces limited tidal flushing and adds to the degradation of the water quality at those locations.

Improved water quality from the creation of the New Inlet is also seen as a short term benefit. As the inlet moves southward, following the natural progression of barrier beach formation, the retention times in the bay will increase. This translates to a reduction in flushing. Increased nitrogen and other contaminant loadings along the bay associated with increasing growth and access, will lead to a decline in water quality. Reduced flushing of Pleasant Bay was calculated to estimate the effects of the New Inlet shifting to its previous location.

Results from the Pleasant Bay Tidal Flushing Study (ACI, 1997) and Pleasant Bay Nitrogen Loading Study (CCC, 1998) are presented below.

RESIDENCE TIME AND VOLUMES IN PLEASANT BAY EMBAYMENT SYSTEM

Embayment	Local Residence Time (Days)		Volume (ft^3)
	Existing	Pre-Break	
Pleasant Bay Estuary	0.98	1.10	1,997,780,000
Bassing Harbor System	1.38	1.56	100,580,000
Ryder Cove	0.93	1.03	30,386,000
Crows Pond	1.77	2.01	51,465,000
Muddy Creek	5.83	7.50	5,391,000
Frost Fish Creek Channel	0.50	0.58	6,630,000

SUMMARY OF EXISTING AND CRITICAL NITROGEN LOADING (kg/yr.)[1] FOR PLEASANT BAY EMBAYMENT SYSTEM					
Embayment	Existing Loading [2]	BBP ORW Critical Load[1]		ORW-N Critical Load[1]	
		Existing	Pre-Break	Existing	Pre-Break
Pleasant Bay Estuary	92,218	2,211,417	1,975,943	1,053,627	938,686
Bassing Harbor System	18,878	79,792	70,843	37,670	33,324
Ryder Cove Total (3) Ryder Cove Proper Frost Fish Creek	15,343 5,473 9,870	35,399	32,042	16,887	15,248
Crows Pond	2,066	32,076	28,367	15,028	13,234
Bassing Harbor (3)	1,469				
Muddy Creek Total Harwich Portion Chatham Portion	10,947 6,480 4,467	662	662	478	372

Notes:1. BBP ORW and ORW-N water quality standards are discussed in the text (Section 4.2 D (3))

2. Existing loadings are based on Cape Cod Commission Technical Bulletin 91-001.

3. Critical nitrogen loadings were not calculated for the Frost Fish Creek, Bassing Harbor and Ryder Cove Proper subembayments, and additional flushing information is being developed (See Section 8.9, Data Gaps)

The results indicate that existing nitrogen loading into the whole Pleasant Bay Estuary Watershed; the whole Bassing Harbor System Watershed (made up of the Crows Pond, Ryder Cove, Frost Fish Creek, and Bassing Harbor subwatersheds), and the Crows Pond subwatershed are well below the critical nitrogen loading for both the water quality standards shown.

Existing nitrogen loading into the Ryder Cove Watershed exceeds the critical nitrogen loading for the ORW-N standard but not for the other standards. A large portion of the Ryder Cove Watershed loading is in the Frost Fish Creek Watershed which discharges into the outer portion of Ryder Cove.

Critical Nitrogen loadings were not calculated for Bassing Harbor though this embayment is expected to accommodate existing nitrogen loading due to the high flushing at that portion of the Bassing Harbor System.

Critical nitrogen loading values were not calculated for the Frost Fish Creek area by the Cape Cod Commission. These values are being researched.

Future nitrogen loadings for the Pleasant Bay Embayments are presented in Chapter 6.

Excerpts from the Commission's Pleasant Bay Nitrogen Loading Study are attached in Appendix E.

e. Other concerns. With the creation of the New Inlet, the increased tidal range

has created other problems including increased shoreline erosion and loss of habitat, especially the eel grass and marshes which provide needed habitat for finfish, shellfish and other wildlife. In addition to these concerns, the need for increased public access, impacts from harbor dredging, and increased growth and development along the shoreline were all cited as concerns in the Pleasant Bay Resource Management Plan.

5. Stage Harbor Embayments.

a. Identification. The Stage Harbor system, located in southeastern Chatham, consists of Stage Harbor, Oyster River, Oyster Pond, Mitchell River, Mill Pond, and Little Mill Pond. The harbor opens to the Nantucket Sound and provides natural, cultural and recreational resources to the Town of Chatham. Stage Harbor and its connected embayments are shown on Figure 4-5.

b. Previous studies. In 1992, Horsley Witten Hegemann, Inc. developed a Comprehensive Harbor Management Plan, to address the needs and concerns regarding Stage Harbor and its connected embayments. As identified in Chapter 2 of this Needs Assessment Report, the report was developed to address the issue, which threaten fishing productivity and the recreational assets of the Harbor system. Some of the more important aspects relevant to the Comprehensive Wastewater Management Study from this report were issues regarding water quality and natural resource protection, quality of shellfishing beds, residential development, endangered wetlands, and marina facilities (specifically marine pumpout facilities).

c. Uses. Stage Harbor, like many harbors throughout Cape Cod, provides a number of natural, cultural, and recreational resources to the area. There are four private marinas located in the harbor: Chatham Yacht Basin, Oyster River Boatyard, Stage Harbor Marine, and Mill Pond Boatyard. Each provides typical marina services including: boat repairs, storage, launching and hauling. Stage Harbor's marinas provide a total of approximately 30 to 40 boat slips.

The Stage Harbor area also has nine town landings, and numerous other harbor facilities including moorings, private piers and a public beach located on Oyster Pond. These additional facilities are well documented in the Harbor Management Plan.

Harbor water uses include tourism, transportation, recreational uses, fishing (both commercial and recreational), and other commercial uses.

d. Water quality concerns. An extensive evaluation of water quality concerns was performed during the development of the Comprehensive Harbor Management Plan. The quality of water in the Stage Harbor system is essential to maintaining the water-based recreational activities such as fishing, swimming diving, beaches, and shellfishing. Potential sources of water quality impacts identified in the Harbor Management Plan include:

- Discharges from subsurface disposal of sanitary sewage;
- Overland flow of storm water and discharge pipes;
- Sewage discharges from vessels in the harbor;
- Wildlife wastes.

The most prominent contaminants resulting from harbor related activities and the contributing watersheds include human pathogens (bacteria and viruses), and nutrients. Most of the sampling results for the harbor area is limited to fecal coliform samples collected by the Commonwealth for shellfish closure purposes. Sample results reported in the Harbor Management Plan were collected between 1984 and 1989. Nine different sampling locations were identified as exceeding the water quality standards for fecal coliform.

As part of the Comprehensive Harbor Management Plan a nitrogen loading assessment was performed. The assessment included the following major components.

- Discussion of the State Coastal Water Quality Standards.
- Bathymetric survey and flushing analysis of the embayments.
- Delineation of the embayment watersheds.
- Calculation of existing and future nitrogen loading.
- Comparison of critical nitrogen loading to existing and future nitrogen loading.

The assessment identified the following findings:

- Mill Pond (Little Mill Pond and Mill Pond combined together) did not exceed the critical nitrogen loading level.

- Oyster Pond, Oyster Pond River, Mitchell River, and Stage Harbor could exceed the critical nitrogen loading levels under various existing and future development scenarios.

Review of the watershed delineation and findings of this study identified the following changes and concerns.

- The watershed delineations for Oyster Pond and Oyster Pond River watersheds have changed since 1992 due to more accurate groundwater elevation information developed and adopted by the Cape Cod Commission.

- The study indicated that Mill Pond would not exceed the critical nitrogen loading, but field observations by Robert Duncanson, Ph.D. at Little Mill Pond identified much algal growth indicating eutrophic conditions. Possibly the deeper water in Little Mill pond was not being completely mixed and flushed out as predicted by the 1992 calculations.

- The 1992 study was one of the first nitrogen loading assessments performed on

Cape Cod, and the assessment methodology has changed since then.

Due to these changes and concerns, Stearns & Wheler was requested to re-assess nitrogen loading to the Stage Harbor embayments based on the methodology used in the Pleasant Bay Nitrogen Loading Study, the revisions to the watershed, and a more detailed investigation of Little Mill Pond.

As part of the re-assessment of nitrogen loading, detailed tidal flushing information for the Stage Harbor embayments was requested from Aubrey Consulting, Inc. (ACI), who had developed the flushing information for the 1992 Comprehensive Management Plan. This flushing information indicated larger embayment volumes and greater flushing than had been presented in the 1992 Comprehensive Management Plan. The explanation of how it differs from information presented in the 1992 Comprehensive Management Plan is attached in Appendix F.

The revised tidal flushing data for the individual Stage Harbor Embayments is presented below.

RESIDENCE TIME, VOLUMES AND AREAS FOR STAGE HARBOR EMBAYMENTS[1]				
Embayment	**Mean Volume (m^3)**	**Tidal Prism Volume (m^3)[2]**	**Local Residence Time (day)[3]**	**Surface Area (m^2)**
Oyster Pond	1,340,000	640,000	1.08	519,000
Oyster Pond River	640,000	410,000	0.81	296,000
Stage Harbor	2,620,000	1,360,000	1.00	1,070,000
Mitchell River	741,000	381,000	1.01	300,000
Mill Pond	769,000	308,000	1.29	235,000
Little Mill Pond	90,200	40,500	1.15	27,600

Notes: 1. Based on information provided by Aubrey Consulting, Inc., February 1999.
2. Calculated from mean high volume minus mean low volume.
3. Calculated by mean volume divided by tidal prism volume times 12.42 hours per tidal cycle.

Existing nitrogen loadings were calculated for these as summarized below.

STAGE HARBOR EMBAYMENTS
SUMMARY OF EXISTING NITROGEN LOADING (kg/yr.)

	EXISTING LOADINGS		
Embayment	**TB 91-001**	**1997 Water Consumption**	**Title 5**
Oyster Pond	5,700	4,200	8,600
Oyster Pond River	5,400	3,500	8,400
Stage Harbor	1,800	1,200	2,200
Mitchell River	1,600	1,200	2,200
Mill Pond	2,700	1,800	3,900
Little Mill Pond	1,900	1,400	2,400

The existing nitrogen loadings based on 1997 water consumption are summarized below with critical nitrogen loading for all the water quality standards.

STAGE HARBOR EMBAYMENTS SUMMARY OF EXISTING LOADINGS (kg/yr.) BASED ON WATER FLOWS AND CRITICAL LOADINGS (kg/yr.) FOR ALL WATER QUALITY STANDARDS					
Embayment	**Existing Loadings**	**CRITAL NITROGEN LOADING**			
		BBP SA	**SA-N**	**BBP-ORW**	**ORW-N**
Oyster Pond	4,200	95,200	67,700	47,600	22,600
Oyster Pond River	3,500	60,600	43,400	30,300	14,500
Stage Harbor	1,200	202,000	144,000	101,000	48,000
Mitchell River	1,200	56,000	40,300	28,300	13,400
Mill Pond	1,800	46,000	32,600	23,000	10,800
Little Mill Pond	1,400	6,000	4,300	3,000	1,400

The existing nitrogen loadings are all below the critical nitrogen loadings except Little Mill Pond, which exceeds the ORW-N standard. These findings are considerably different from the findings published in the Comprehensive Harbor Management plan (HWH, 1992) due to revised flushing information. That change is described in a letter from Aubrey Consulting, Inc. in Appendix F.

Future nitrogen loadings for the Stage Harbor Embayments are presented in Chapter 6.

e. Other concerns. There is a much needed balance between the increasing need for public access and usage, with the protection of natural habitats and other resources that the harbor provides. Town character, scenic views, the local fishing economy, recreation, harbor navigation and safety, and natural habitats were all cited in the Harbor Management Plan as major concerns.

The Comprehensive Harbor Management Plan recommended amending the Town Board of Health nitrogen loading regulation to limit nitrogen to 5 ppm (or to a level that will protect marine

resources) in the Stage Harbor coastal embayments. The Town Board of Health has not yet implemented this recommendation due to uncertainty on the amount of nitrogen that must be limited to protect the marine resources.

6. South Coast Embayments

a. Identification. The South coast Embayments are located along Chatham's south coast and include the Taylor Pond/Mill Creek embayment, Cockle Cove Creek, and Sulfur Springs/Buck Creek embayment. These embayments and watersheds are illustrated on Figure 4-5.

b. Previous studies. No previous studies were found specifically on these embayments. The landfill closure studies and studies associated with the Chatham WPCF have investigated groundwater impacts to this area, and reported limited groundwater sampling in this area. No significant environmental impacts have been reported for this area due to the Chatham WPCF and landfill.

c. Site visits and bathymetric survey. Several site visits have been made to these embayments to understand their uses, investigate environmental impacts, and to perform a bathymetric survey on which the nitrogen loading assessment was based. A summary of the bathymetric survey and tidal flushing calculations is attached as Appendix G.

d. Taylor Pond and Mill Creek description. Taylor Pond is approximately 50,300 m^2 (12.4 acres) in area, and is surrounded by bluffs on which year-round and summer residences have been developed. The pond is used for boating, boat mooring, swimming, and shellfishing during the seasonally approved period of November 1 through May 31. The pond has great scenic beauty.

Taylor Pond was probably a kettle hole pond, which was breached by the coastal waters. It is relatively deep and its outlet is restricted by a shelf that has less than two feet of water at low tide.

This shelf and shallow waters in Mill Creek restrict boating traffic to Taylor Pond at low tide. Also, the shelf may restrict complete mixing of the pond at high tide.

The Town has a public landing on the southeastern corner of Taylor Pond. Stormwater discharge at this location introduces fecal coliform to the pond and contributes to shellfish closures in the summer months. Portions of this stormwater discharge were remediated in 1998. Some stormwater continues and further remediation is planned after a decision is made on how to best reconfigure the boat ramp.

During a site visit in April 1998, patches of algae were observed near the landing and on the pond's northern shore where a tide gauge was located. Groundwater was emerging from the bank and flowing over the algae into the pond.

Mill Creek is relatively narrow and shallow where it exits Taylor Pond south to a large salt mash system and mud flat. The creek continues south to Nantucket Sound. Average depth of the Creek is 1.25 meters (4.1 feet) at high tide and 0.28 meters (0.9 feet) at low tide. Many seasonal residence over look the creek at its northern third. Minimal algal growth was observed on the banks of Mill Creek.

The Town maintains the Mill Creek Landing, which is located on the creeks western bank off Mill Creek Road. Stormwater impacts of sedimentation and algal growth were evident at the landing. Stormwater remediation has been planned at this landing.

Shellfishing in Mill Creek is closed during the same period as Taylor Pond due to stormwater impacts and fecal coliform, which probably originate from the large salt marsh system and waterfowl.

The watershed for the Taylor Pond and Mill Creek embayment covers a large area as shown in Figure 4-5.

e. Cockle Cove Creek description. Cockle Cove Creek is a narrow channel surrounded by fresh water wetlands to the north, and salt marsh in the south. It has a relatively small, narrow watershed which contains the Chatham WPCF and one-half of the landfill at its northern end. Figure 4-5 shows the creek and its watershed.

Cockle Cove Creek is more of a creek than a true embayment. It drains nearly completely during low tide, at which time it contains much fresh water flow. It was too shallow to perform a bathymetric survey. As a result, it could not be evaluated for critical nitrogen loading because the tidal prism makes up nearly the whole volume of the creek at high tide indicating a very low retention time.

Due to the unique nature and high tidal flushing of this creek, the Cape Cod Commission requested that the Town establish a flow metering station in the upper reaches of the creek where flow and water quality could be monitored. This monitoring station was established in March 1999 as shown on the map in Appendix G. A V-notch weir was installed in the upper reaches of the creek just before it enters a culvert used for a long abandoned cranberry bog operation. The flow will be monitored weekly, and the water quality will be analyzed monthly for the following parameters.

- TKN
- Nitrate and nitrite
- Alkalinity
- Field parameters

The first four flow meter readings indicate a flow of 31,200 gpd. This is less than the average effluent flow of the Chatham WPCF, which was approximately 80,000 gpd in 1997. The groundwater from this area could be discharging further south in the watershed. Water quality data will be reported in following project reports.

Cockle Cove Creek is a permanent shellfish closure due to fecal coliform impacts from stormwater (from Ridge Vale Road) and the surrounding wetlands. Also, it is considered by the Town and State as a small shellfish resource, and minimal sampling and other field work have been done to turn it into a resource.

f. Sulfur Springs and Bucks Creek description. Sulfur Springs is an expansive (36 acres) shallow embayment that turns into a mud flat at low tide. The east channel dries up at low tide. The embayment bottom on the northwest side is very soft and mucky. This muck is probably a source of sulfur dioxide, which gives it a distinctive low-tide odor, and may be the source of its name.

Bucks Creek drains the embayment to Nantucket Sound through a salt marsh system. The mouth of Bucks Creek reconfigures itself monthly.

This area is a large open space and provides scenic beauty to the seasonal and year-round houses constructed on several areas around the embayment and salt marsh. It is typically not used for swimming or boating.

This area is closed to shellfishing from May 15 to December 15 due fecal coliform from wetlands and waterfowl.

g. Nitrogen loading assessment. A bathymetric survey was performed for the Taylor Pond/Mill Creek and Sulfur Spring/Bucks Creek embayments as described in Appendix G. The main findings of that survey are summarized below.

RESIDENCE TIME, VOLUMES, AND AREAS FOR SOUTH COAST EMBAYMENTS				
Embayment	**Mean Volume (m^3)**	**Tidal Prism Volume (m^3)**	**Local Residence Time (day)**	**Surface Area (m^2)**
Taylor Pond	75,500	40,900	0.94	50,300
Mill Creek	61,300	76,100	0.42	79,400
Taylor Pond/Mill Creek	136,700	117,000	0.60	129,700
Sulfur Springs	73,600	108,800	0.35	146,800
Bucks Creek	31,000	35,900	0.45	43,700
Sulfur Springs/Bucks Creek	104,600	144,700	0.38	190,500

Critical nitrogen loadings were calculated for these embayments as described earlier in this chapter section. Existing nitrogen loading was also calculated for these embayments as described earlier. These existing nitrogen loading values are summarized below.

SOUTH COAST EMBAYMENTS SUMMARY OF EXISTING NITROGEN LOADING (kg/yr.)			
Embayment	**EXISTING LOADINGS**		
	TB 91-001	**1997 Water Consumption**	**Title 5**
Taylor Pond	5,000	2,800	6,900
Mill Creek	4,000	2,200	5,500
Taylor Pond/Mill Creek	9,000	5,000	12,400
Sulfur Springs	8,700	5,600	12,400
Bucks Creek	1,100	600	1,500
Sulfur Springs/Bucks Creek	9,800	6,200	13,900
Cockle Cove Creek	4,700	3,100	6,300

The existing nitrogen loadings based on 1997 water consumption are also summarized below with critical nitrogen loading values for all the water quality standards.

SOUTH COAST EMBAYMENTS SUMMARY OF EXISTING LOADINGS (kg/yr.) BASED ON WATER FLOWS AND CRITICAL LOADINGS (kg/yr.) FOR ALL WATER QUALITY STANDARDS					
Embayment	**Existing Loading**	**CRITICAL NITROGEN LOADING**			
		BBP - SA	**SA-N**	**BBP-ORW**	**ORW-N**
Taylor Pond	2,800	6,100	4,300	3,100	1,400
Mill Creek	2,200	11,100	8,100	5,500	2,700
Taylor Pond/Mill Creek	5,000	17,200	12,400	8,500	4,100
Sulfur Springs	5,600	15,800	11,500	7,900	3,800
Bucks Creek	600	5,300	3,800	2,600	1,300
Sulfur Springs/Bucks Creek	6,200	21,000	15,300	10,500	5,100
Cockle Cove Creek	3,100	-	-	-	-

The existing nitrogen loadings based on 1997 water flow for all embayments are lower than the critical nitrogen loadings for the BBP-SA standard. Only Taylor Pond and Sulfur Springs exceed the ORW-N standard, which is the most stringent.

The evaluation of Cockle Cove Creek is different from the other embayments and watersheds evaluated. As discussed previously, it is a creek and not a true embayment, therefore, a critical nitrogen loading value could not be calculated for it. Also, its watershed contains the Chatham WPCF and half of the landfill, both of which contribute nitrogen to the watershed. The existing nitrogen loading to the Cockle Cove Watershed is further detailed below.

EXISTING NITROGEN LOADING IN COCKLE COVE CREEK WATERSHED			
Nitrogen Sources	**NITROGEN LOADING kg/yr.**		
	TB 91-001	**1997 Water**	**Title 5**
On-Site Systems	2,962	1,384	4,667
Impervious Areas	240	218	218
Lawn Areas	442	442	442
Natural Areas	25	22	22
Landfill	206	206	206
Chatham WPCF	778	778	778
Total	**4,653**	**3,050**	**6,333**

This table illustrates that the only difference between the existing nitrogen loading values that are calculated for an embayment watershed is the way that wastewater nitrogen loading is calculated.

The Chatham WPCF nitrogen loading is based on the following factors.

- Average 1997 total nitrogen effluent concentration of 5 ppm.
- Average 1997 total effluent flow of 0.112mgd.

The loading from the Chatham WPCF was 1,777 kg/yr. in 1995 before the WPCF was converted to a nitrogen removal system. That loading was 1000 kg/yr. greater than the existing loading. No nitrogen impact to Cockle Cove Creek was reported at that time.

The loading from the landfill is estimated by the area of the landfill in the watershed (approximately 13acres), 40 inches of precipitation, and an average groundwater total nitrogen concentration of 4 ppm, which was observed down gradient of the landfill. This produced a loading of 210 kg/yr. as listed above. It is noted that the landfill is now capped, therefore, the nitrogen leached from the buried refuse will decrease to zero over time.

7. Shellfish Closures.

a. Introduction. Chatham's shellfishing industry is an important part of the Town's economy. Bay scallops, quahogs, soft-shell clams, oysters, and mussels are harvested. Of these species, the quahog, soft-shell clams, and the bay scallop are the most commercially fished in Chatham. Shellfish productivity has varied over the years. Quahog production has been consistent in Town and has shown increasing trends in the past years. Chatham implements a propagation program to increase populations of shellfish and increase the Town's shellfish habitats. Currently the Town stocks quahogs, oysters and soft-shell clams (HWH, 1992). The Chatham Shellfish Constable estimated the wholesale value of the shellfish fisheries at over $5M. This represents a 500 percent increase in value over the past ten years. The shellfishing resources are an extremely important resource to the year round residents of Chatham as it provides year round jobs and cycles money through the entire Town economy.

b. Closures. The Division of Marine Fisheries (DMF) and the Town Shellfish Constable evaluate shellfish habitats and designate which areas are available for shellfish harvesting. Stormwater, waterfowl, and wetlands are typically responsible for high levels of coliform found in surface waters. These impacts are then compounded by limited tidal flushing in some areas. On-site wastewater treatment systems (particularly failed systems) and direct discharge of wastes from vessel waste holding tanks to the harbors can also cause shellfish bed closures.

As of the beginning of 1998, five areas in Chatham were identified as permanently closed shellfish beds by the Town Shellfish Department. These areas included: Muddy Creek (above Route 28), Red River, Frost Fish Creek, Cockle Cove Creek, and the upper portion of Oyster Pond. Poor flushing, waterfowl and stormwater discharge are the most commonly cited reasons for the closures in these areas, although Red River Creek, Frost Fish Creek, and Cockle Cove Creek are perceived as a limited resource, and minimal work has been performed to open these areas to shellfishing. The upper portion of Oyster pond has been closed due to a stormwater discharge from the downtown area.

Several other areas have been identified as seasonally closed/conditionally approved areas. Lower portions of Oyster Pond are closed from June 1 until November 30 as a result of stormwater discharges into this area. Taylors Pond is impacted from stormwater discharge and runoff, and is closed from June 1 until October 31. Mill Creek is closed during this time due to High coliform counts. Bucks Creek is closed seasonally from May 15 to December 15 as a result of high coliform counts from waterfowl and wetlands. The portion of Muddy Creek between Route 28 and Pleasant Bay is also seasonally closed from July 1 to December 1 as a result of stormwater impacts.

The Massachusetts Division of Marine Fisheries (DMF) also identified five "marina closures" at the following marinas: Stage Harbor Marina, Oyster River Boatyard, Chatham Yacht Basin, Outermost Marina, and Ryders Cove Marina. A "marina closure" is a shellfish closure made by the DMF because there is a high risk of sewage discharge from boats at these areas.

Shellfishing has been identified as an important resource to the Town, and shellfish closures are of great concern.

F. Wetlands. Wetlands result from both salt and freshwater, and are valuable for flood protection, nutrient uptake and release, wild life habitat and prorogation, groundwater recharge and open space for recreation and scenic beauty. This section summarizes the Town's wetlands as documented in the Monomoy Capacity Study (CCC, 1996).

Salt marshes comprise 1,120 acres or approximately ten percent of the Town. The largest salt marshes are located behind the barrier beaches along Nantucket Sound. In addition, the Town has 2,230 acres of tidal flats, 1, 100 acres of marine flats, and 1,130 acres of estuarine flats.

Several specific natural wetland resources have also been identified in Chatham in the following locations:

Salt Marshes:

Strong Island	Little Mill Pond	Nauset Beach
Red River	Forest Beach/Mill Creek	Cockle Cove Creek
Buck's Creek	Harding Beach	Morris Island
Oyster Pond	Oyster River	Mitchell River

Cedar Swamps:

South of Cedar Street

Vernal Pools:

Northwest of Salt Pond

Coastal Plain Pond Shores:

Lover's Lake	Stillwater Pond	Blue Pond
Black Pond	White Pond	Perch Pond
Bear Pond	Emery Pond	Schoolhouse Pond
Goose Pond	Ministers Pond	

Wetlands are identified in Figure 4-4. The delineations were developed from Massachusetts DEP mapping. Each of these wetlands is delineated with a 100-foot buffer zone, which is established based on Federal and State wetland regulations and Chatham's local regulations regarding onsite treatment systems. According to the Title 5 regulations (310 CMR 15.0000), the minimum setback requirement for Bordering Vegetated Wetlands (BVW), salt marshes, and inland and coastal banks is 50 feet for Soil Absorption Systems. The Town of Chatham has expanded these setbacks. According to the "Town of Chatham – Minimum Requirements For the Subsurface Disposal of Sanitary Sewage", no disposal facility shall be closer than 100 feet to a watercourse. A watercourse is defined as:

> *Any natural or man-made stream, pond, lake, wetland, coastal wetland, swamp, or other body of water and shall include wet meadows, marshes, swamps, bogs, and areas where groundwater, flowing or standing surface water, or ice provides a significant part of the supporting substrate for a plant community for at least five (5) months of the year.*

G. Floodplains and Velocity Zones. Floodplains are nature's way of buffering land from excessive storm events because they act to dissipate the wind and wave action generated during these storms. The Town of Chatham Protective By-law prohibits new development within areas designated as V (Velocity) Zones by the Federal Flood Insurance Program. V-Zones are designated by the Federal Emergency Management Agency (FEMA) and are defined as areas susceptible to 100 year coastal flooding with high velocity wave action. The V-Zones are illustrated in Figure 4-5.

A-Zones are also designated by FEMA and are areas where flooding is predicted to occur once every 100 years. This flooding occurs with minimal associated wave action, and these areas are located landward of the V-Zones, typically in salt marshes and low elevation areas of Chatham. The surface elevations in these areas typically lie below ten feet MSL. The A-Zones are illustrated in Figure 4-5.

H. Forests. As a result of Chatham's rapid development throughout the years, forests and open space have been dramatically reduced. According to the Open Space and Recreation Plan developed by the Town of Chatham in 1985, the Town has experienced a 20 percent reduction in total forested area from 1951 to 1980. The plan also identified that only 21 percent of the Town at that time was forest. The Town Forest is the largest single wooded area owned by the Town at 148 acres. The forest is located along the western side of the Town along the Chatham/Harwich Town line. The Mill Pond Well Site property contains 18 acres of forest (Chatham Planning Department).

I. Protected Natural Areas.

1. Massachusetts Natural Heritage Program. The Massachusetts Natural Heritage Program (MNHP) maintains an atlas of estimated habitats and priority sites for rare plants and wildlife on Cape Cod. The atlas identifies estimated habitat, which should be protected for these

species. The atlas will be utilized in Phase 400 and 500 as facility sites are identified and evaluated.

2. Area of Critical Environmental Concerns. The area of Critical Environmental Concern (ACEC) is located in the northern portion of Chatham. The major water bodies and landmasses identified in the ACEC are: Mill Pond (in northwest Chatham), Muddy Creek, Minister Pond, Lovers Lake, Stillwater Pond, Frost Fish Creek, Pleasant Bay, Ryder's Cove, Crows Pond, Bassing Harbor, and Strong Island. These areas are part of the state designated ACEC for Pleasant Bay. The entire Pleasant Bay ACEC is over 9000 acres and includes 12 threatened or endangered species, with an additional 16 species identified as of special concern in Massachusetts. The Pleasant Bay Resource Management Plan (Pleasant Bay TAC, ET al., 1998) recommended a southward expansion of the ACEC. The existing ACEC and proposed expansion are illustrated in Figure 4-5.

3. Chatham Conservation Foundation Lands. This Conservation Trust is one of the oldest land trusts on Cape Cod. The trust has accumulated over 550 acres (Chatham Planning Department) of land throughout Chatham, via private purchase, donation, and easements. These lands are used as open space and recreational areas. Some of these lands have hiking trails while other lands are protected as natural habitats.

4. Cape Cod National Seashore. In 1961, the United States Congress established the Cape Cod National Seashore (CCNS) as part of the National Park Service. The CCNS was developed to protect sensitive natural, cultural, and recreational resources on Cape Cod. The southern portion of Nauset Beach is the only portion of the CCNS, which exists in Chatham. Currently it is undeveloped and is separated from mainland Chatham by Chatham Harbor and Pleasant Bay. Portions of this barrier beach have been identified as a habitat for species protected by both the Commonwealth of Massachusetts and the Federal Government. South Beach is also part of the CCNS although the beach is owned by the Town (Chatham Planning Department).

5. Areas of Critical Marine Habitat. The Pleasant Bay Resource Management Plan in 1998 identified several critical marine habitats including four in Chatham waters. These areas include: sandy tidal flats, muddy tidal flats, eelgrass beds, fringe marsh, and areas of freshwater up welling. These areas provide much needed habitats for finfish, shellfish and other aquatic wildlife.

Those areas designated by the plan are:

- The intertidal zone and flats north of Tern Island, south of Ministers Point, and west of the channel.

- The intertidal zone and flats south, east, and west of Strong Island.

- The intertidal zone of Nickerson's Neck from the Strong Island Town Landing to the southeastern tip of Fox Hill.

- The intertidal zone of Nickerson's Neck from the Chatham Yacht Club north to the 7th tee of Eastward Ho! Country Club.

4.3 LAND USE AND ZONING

A. Number of Chatham Properties and State Land Use Classifications.

Analysis of 1997 assessor's data indicates a total of 7,697 assessed properties. Each of these properties is assigned a standard State land use code to allow tax assessment of the properties. These properties and tax codes have been evaluated and summarized into the following groupings.

SUMMARY OF CHATHAM LAND USE			
Land Use Grouping	**State Land Codes in Grouping**	**Total Number of Properties**	**Percentage of Total**
Single Family Residential	101	5,266	69
Multi Family Residential	102, 104, 105, 106, 107, 111, 112, 123, 130, 131, 304	1,452	19
Commercial	31, 301,302, 303, 310, 315, 316,321, 322, 324, 325, 326, 330, 331, 332, 333, 334, 340, 341, 342, 361, 364, 374, 380, 381, 384, 390, 391, 805	413	5
Industrial	400, 401, 402, 403, 410, 424, 425, 430, 433, 440, 441	93	1
Institutional	350, 352, 355, 900, 901, 902, 903, 904, 905, 906, 908, 910, 920	289	4
Undevelopable, Vacant, Forest or Easement Land	132, 200, 392,393, 601,710,720	186	2
Total	-	**7,697**	**100**

A Geographic Information System (GIS) database has been developed for this Study, which includes land use information for these properties. These properties are depicted on Figure 4-1, which is

based on the 1994 Tax Assessor map. Figure 4-1 (and other GIS maps presented in this report) contains a total of 7,502 parcels of which 450 are ponds, roads, or undevelopable properties.

Comparison of the number of properties in the GIS database and in the Tax Assessor data indicates that the GIS database contains 264 more undevelopable properties. This is due to the Tax Assessor not being able to generate any tax revenue from many small undevelopable and/or wetland properties. It also indicates that the Tax Assessor data contains 461 additional properties, of which 320 are condominiums that are not depicted on the map. The remaining 141 properties that are not shown on the map are believed to be subdivided properties since 1994.

The GIS database is the basis of many evaluations used in this Study. It has the ability to geographically locate various Town characteristics (water use, nitrogen loading, flood zones, etc.) on a map. Great care was taken to accurately enter Town Assessor data into the parcels that are represented on Figure 4-1 so that the findings of these evaluations would be as accurate as possible.

B. Town Zoning. Several zoning requirements have been established for the Town of Chatham with respect to new development. These include minimum: lot sizes, frontage, road setbacks, abutters setbacks, conservancy district setbacks, and parking setbacks. In addition, maximum building heights, lot coverage, building coverage, and green areas required have also been established. The requirements for these dimensions vary by zoning class and are identified in the Chatham Protective By-law.

The Town of Chatham is divided into seven major zoning districts: Residential, Small Business, General Business, Industrial, Residence-Seashore Conservancy, Municipal, Municipal Conservancy. The residential and small business groups are subdivided to account for more specific classifications.

C. Protected Cultural Areas. The Town of Chatham has many historical sites identified in several documents. The proposed historic preservation and community character

element of the Town's LCP (November 1997) presents the most complete listing of historic sites.

4.4 TOWN DEMOGRAPHICS

A. Current Population. The most comprehensive document on Chatham's current population was developed as part of the Chatham Community Profile drafted in 1994. This document provides the US Census data since the turn of the century, and provides a brief description of the Town's growth during that period. Another recent study, developed by UMass Amherst, projected future populations of Chatham and other towns of Cape Cod.

The Massachusetts Institute for Social and Economic Research (MISER), University of Massachusetts Amherst published "Projections of the Populations (for) Massachusetts Cities and Towns, Years 2000 and 2010", in December of 1994. This report investigated year-round population migration in and out of Chatham. This report projected that Chatham would reach a peak year-round population of 6,579 in 1990 followed by a decline in population to 6,068 by the year 2010.

The Monomoy Capacity Study developed by the Cape Cod Commission in 1996 also projected future populations as part of the Fiscal Impact Analysis performed for this study. They projected populations for Chatham through the year 2015. Unlike the MISER study, the Monomoy Capacity Study projected constant population growth from 6,733 in 2001 to a population of 7,594 in 2015. They also projected a population in 2015 of 10,532 if there was a 50 percent shift of seasonal homes to year round homes in the final year.

1. Year round population. Federal census data indicates that Chatham's year round population has grown from 1,737 people in 1920, to 3,273 in 1960, to a population of 6,579 in 1990. This indicates a rapid growth during the 70s and 80s, which experienced growth rates of

30 to 40 percent. A year round population of 6,930 is adopted for 1996, as estimated by the US Census Bureau. A year-round population of 7,000 is adopted for 1997 based on the average growth seen in the census data from 1990 to 1996. This trend is shown in Figure 4-6.

2. Seasonal populations. Seasonal populations on Cape Cod are the most difficult to predict. These populations are a combination of the following distinct groups.

- Year round residents: This refers to the permanent populations indicated by the United States Census.

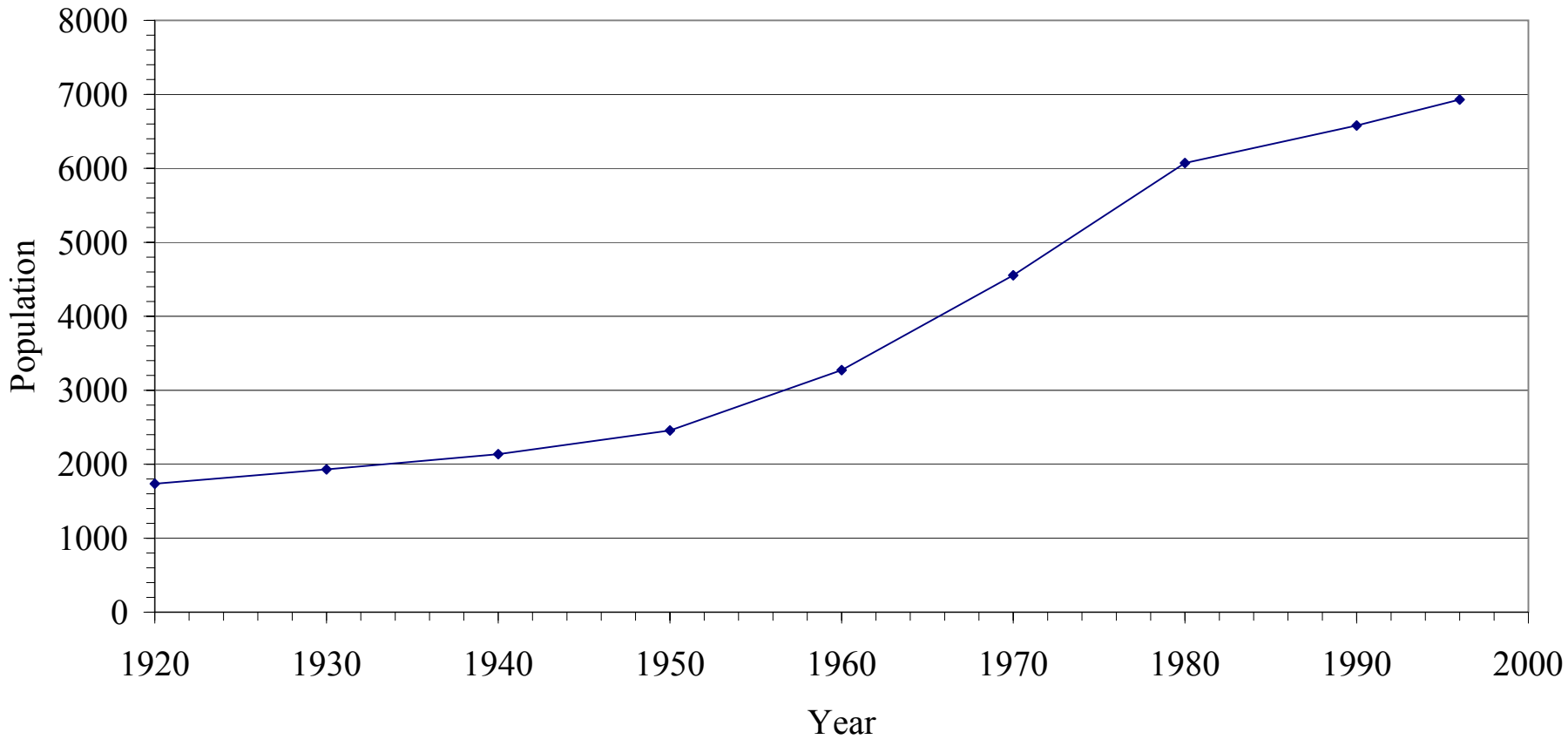
- Second homeowners: This is the population group that owns summer homes in Chatham.

- Visitors and guests of homeowners: This is the population group that are visitors or guests of year round or second homeowners. The number of these visitors is difficult to estimate and will vary from week to week and month to month.

- Vacationers: This group can be described as those who visit Chatham and find lodging in hotels, motels, and rental cottages.

- Day-trippers: These are the people who travel to Chatham, but do not stay overnight, and are the most difficult population group to estimate.

The Town of Chatham Planning Department estimates the summer population to be in the range of 20,000 to 24,000 people. This is four times the year round population based on US Census data. The CCC had similar projections of 20,000 to 23,600 people in Chatham during the summer months (CapeTrends, 1996). According to the Town's Police Department these numbers could be even closer to 25,000 to 30,000 people (Friends of Chatham Waterways, 1996).



Notes:

1. Populations for 1920 through 1990 are from U.S. census data
2. Population for 1996 is an estimate from the US Census Bureau

Figure 4-6

Census Population Data

Comprehensive Wastewater Management Planning Study
Town of Chatham, MA

Stearns & Wheler, LLC
Environmental Engineers and Scientists

Discussion with the Chatham Chamber of Commerce in July 1998 indicated the following seasonal populations based on their understanding of population variation in Chatham.

- July and August population of 25,000
- Winter (February) population of 6,000
- Peak weekend population of 30,000

These seasonal populations (from the Chamber of Commerce) are adopted for Chatham.

B. Resident Characteristics.

1. Age group. According to a study performed in 1996, over one-third of the Town's year round residents are aged 65 and older (Friends of Chatham Waterways, 1996). This is the highest percentage in the state, at more than twice the state average. Based on 1990 US Census data, 20 percent of Chatham's population was 24 and younger, 45 percent were ages 25 to 64 years old and 35 percent were 65 and over. The median age for Chatham, based on the US Census data, was 51 years old, which is the oldest of all Cape Cod towns (CapeTrends, 1996).

2. Income and tax burden. The Chatham Economic Study developed in 1996 provides the most comprehensive information on Chatham's economy. The study was based on the 1990 US Census data. According to the study, Chatham's income per capita was $18,471 and was the second highest on the Cape. The report identified that in 1990, 344 of Chatham's residents were below the poverty line and account for approximately 5 percent of the year round population. Fifty-five percent of the year round residents receive their income from wages and salaries, 47 percent from Social Security, 30 percent from retirement, 18 percent from self employment, and four percent from public assistance.

Chatham's unemployment has been estimated by the Town and the State to vary with the seasons. During the winter months the unemployment rates have been as high as 12 percent, and as low as 2

percent in the summer. The average yearly rate of unemployment in Chatham remains close to five or six percent.

The Cape Cod Commission document "Cape Trends" reports that the average 1995 tax bill for single family homes in Chatham was $1,846. This value was the sixth highest in Barnstable County. The State median tax bill for single family homes is $1,872 with 339 towns reporting (Cape Trends, 1996).

The Town's major source of income is provided by the service industry, corresponding to the summer tourism. In 1996, the Town conducted a census on employment in Chatham. Forty-two percent of the work force was employed in services, 16 percent in agriculture and fishing, 13 percent in retail trade, 11 percent in construction, 10 percent in finance, 5 percent transportation/ communication, 3 percent in government, an 1 percent in manufacturing (Friends of Chatham Waterways, 1996). In the past ten years there has been a large increase in service and retail jobs and a large decrease in construction, the remainder of the work force has remained steady (Friends of Chatham Waterways, 1996).